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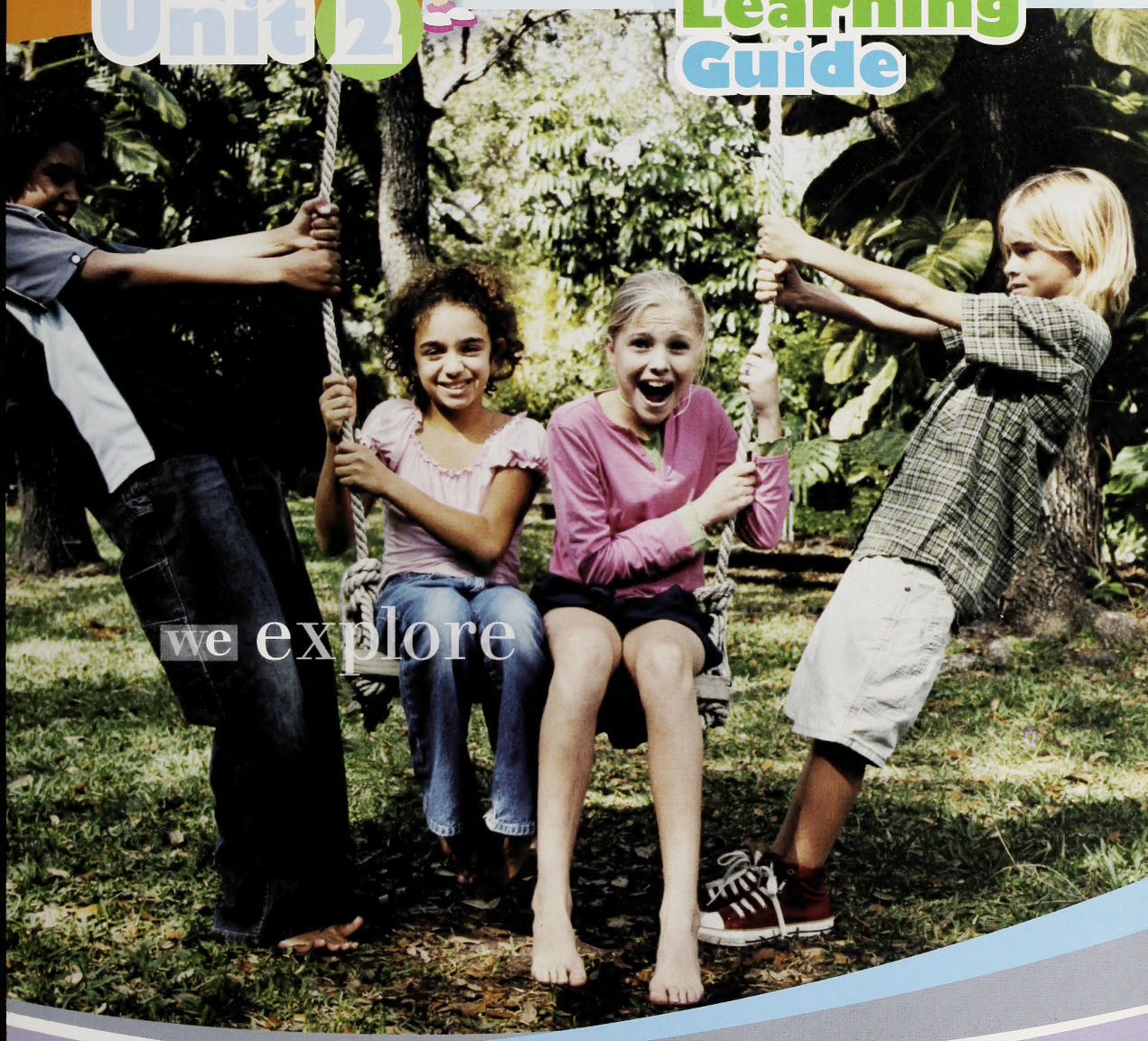
Learn EveryWare

Math 5 Unit 2

Student Learning Guide



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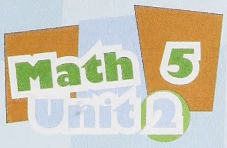

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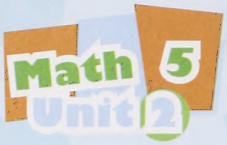

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Math 5 Unit 2

Table of Contents

Lesson 1: Completing Patterns 1

Lesson 2: Describing Patterns 11

Lesson 3: Pattern Rules 21

Lesson 4: Making Predictions 35

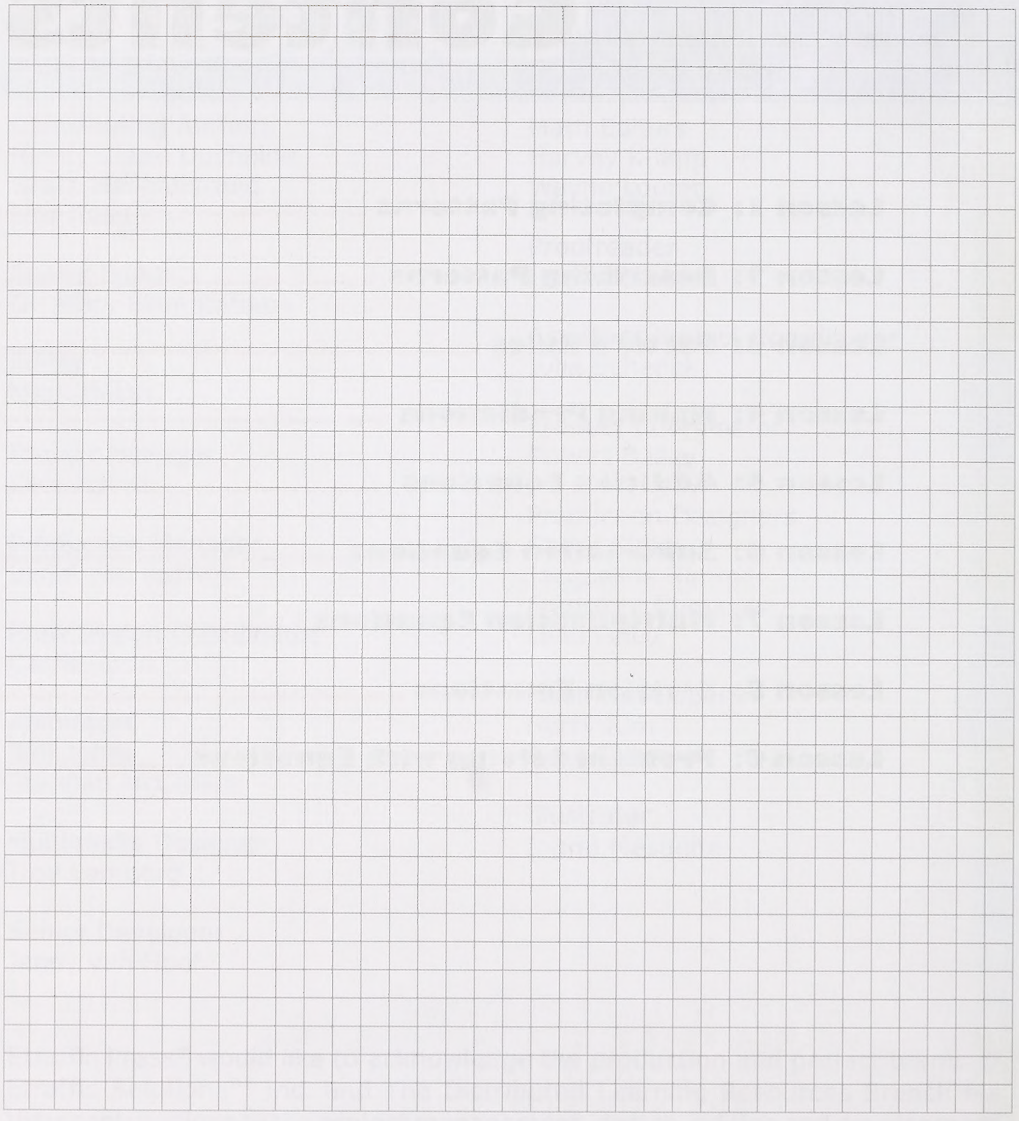
Lesson 5: Addition Equations 47

Lesson 6: Subtraction Equations 65

Lesson 7: Multiplication Equations 79

Lesson 8: Division Equations 93

Lesson 9: Problem Solving with Equations 103



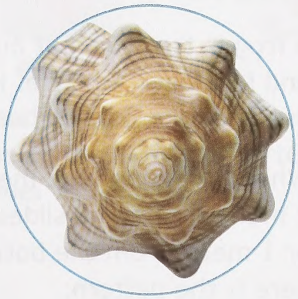
Lesson 1

Completing Patterns

Patterns

A pattern is a group of numbers or objects that follow a rule. This can also be called a **relation**. Almost everywhere you look you will see patterns. Here are two common patterns that you can see in nature.

Honeycomb Pattern



Shell Pattern

Look around your room or home. You should find patterns all around you.

Reflection

Think about the patterns that you find? What do you think makes them a pattern?

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Extend a given pattern with and without concrete materials, and explain how each element differs from the preceding one
- Determine and explain why a given number is or is not the next element in a pattern
- Predict subsequent elements in a pattern

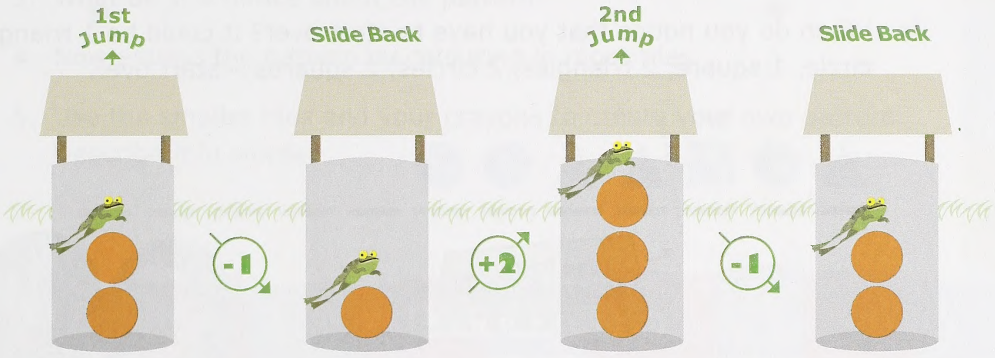
Frog Jump

A frog is trying to get out of a well. He jumps up 2 metres and falls back 1 metre. He repeats this pattern until he finally gets out of the well.

When he jumps up 2 metres from the bottom he will be at 2 metres. Then he slides back 1 metre so that is 2 – 1 = 1 or 1 metre from the bottom of the well. This repeats, so here is the pattern:

	Jump	Slide Back	Jump	Slide Back	Jump	Slide Back
Height in Metres	2	1	3	2	4	3
		-1	+2	-1	+2	-1

If the well is 5 metres deep the frog should make it out after making 4 jumps. You can extend patterns to find answers using models like counters:



There is a page of Square Counters at the end of this Unit in your Workbook. Cut them out and use them to help you show this pattern. Keep the Square Counters when you are done. You will be using them again.

Extending a Pattern

To be able to extend, or continue a pattern you must first determine what shapes or objects are in the design. You must study the design and find the repeated pattern. Here's an example.

Example 1

You can extend a given pattern by finding the rule it follows.

Study the following example:

What are the next five shapes in the pattern?

Cut out and use the Pattern Blocks from your Workbook to recreate the pattern. You will find them at the end of this Unit in your Workbook.

When do you notice that you have to start over? It could be 1 triangle, 1 circle, 1 square, 2 triangles, 2 circles, 2 squares – start over.

So the next five shapes in the pattern are:

Exploration 1: Tile Patterns

Materials: Unit 2, Lesson 1, Exploration 1 page from your Workbook, A pencil, Crayons

Mrs. Jones is planning the new floor for her house. She is having tiles installed in a pattern in her kitchen. She has decided to use 4 different colours in her pattern.

1. Study the tile pattern that Mrs. Jones has chosen for her kitchen floor.
2. Reproduce the pattern using your crayons. Use the tile grid provided.
3. What do you notice about the pattern?
4. Now extend the pattern by colouring in more tiles.
5. Use the smaller tiles and your crayons to create your own pattern. Describe it in words.

Exploration 2: Long Jump

Materials: Unit 2, Lesson 1, Exploration 2 page from your Workbook, Square Counters, Pencil

David is practicing the long jump so he can compete in the next track meet. He keeps a record of his jumps in a chart.

Day	Metres
Monday	2
Tuesday	2.5
Wednesday	3
Thursday	
Friday	

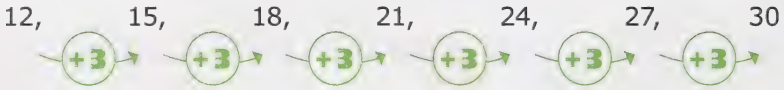
1. Using you Square Counters, make a model of the information shown in the chart.

2. Explain why the pattern in your model is the same as the pattern in the chart.

3. Decide if David will be able to jump four metres on Friday.

Determining the Next Element in a Pattern

Sometimes you may be presented with an incomplete pattern and you will need to fill in the missing numbers. Your first step is to determine the pattern for the sequence.



In this case, the pattern is 'add 3 to each number'.

Your observation of the pattern is called a **generalization**. You can use a generalization to find the other elements.

Example 2

Will the number 20 or 21 be the missing number in the following pattern?

7, 14, _____, 28, 35, 42

Look at the information in the problem. What do you notice about the numbers?

Can you add or multiply to get from one number to the next in the pattern?

You should notice that you can add 7 to each number to get the next number in the pattern.

Now use the generalization you have made to find the missing number or element.

7, 14, 21, 28, 35, 42

Predicting Subsequent Elements

There will be times when you may need to predict what **element** will come next in a pattern. You will need to determine the relationship or connection within the pattern.

You can do this by using your generalization, or conclusion that you believe is true in most cases. Here's an example.

Example 3

Study the following pattern:

A. Predict the next element in the pattern by describing it in words.

Look at the pattern and determine what you see.

In this pattern all of the elements are the same shape. They differ in size and darkness.

The next sun in this pattern will be larger and darker than the sun immediately before it.

B. What generalization and/or conclusion can you make about this pattern?

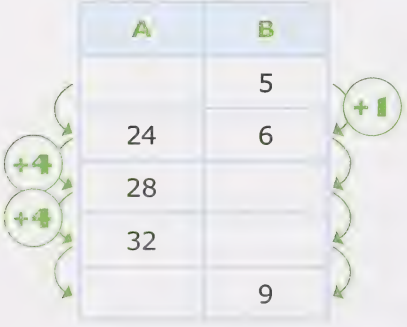
The suns are getting larger while the colour is getting darker.

Example 4

What numbers are missing in the following table?

A	B
	5
24	6
28	
32	
	9

Look for a number that you can add to each number in a column to complete the pattern. Here is a diagram that shows you a way to complete the pattern.



What generalization can you make about the missing numbers?

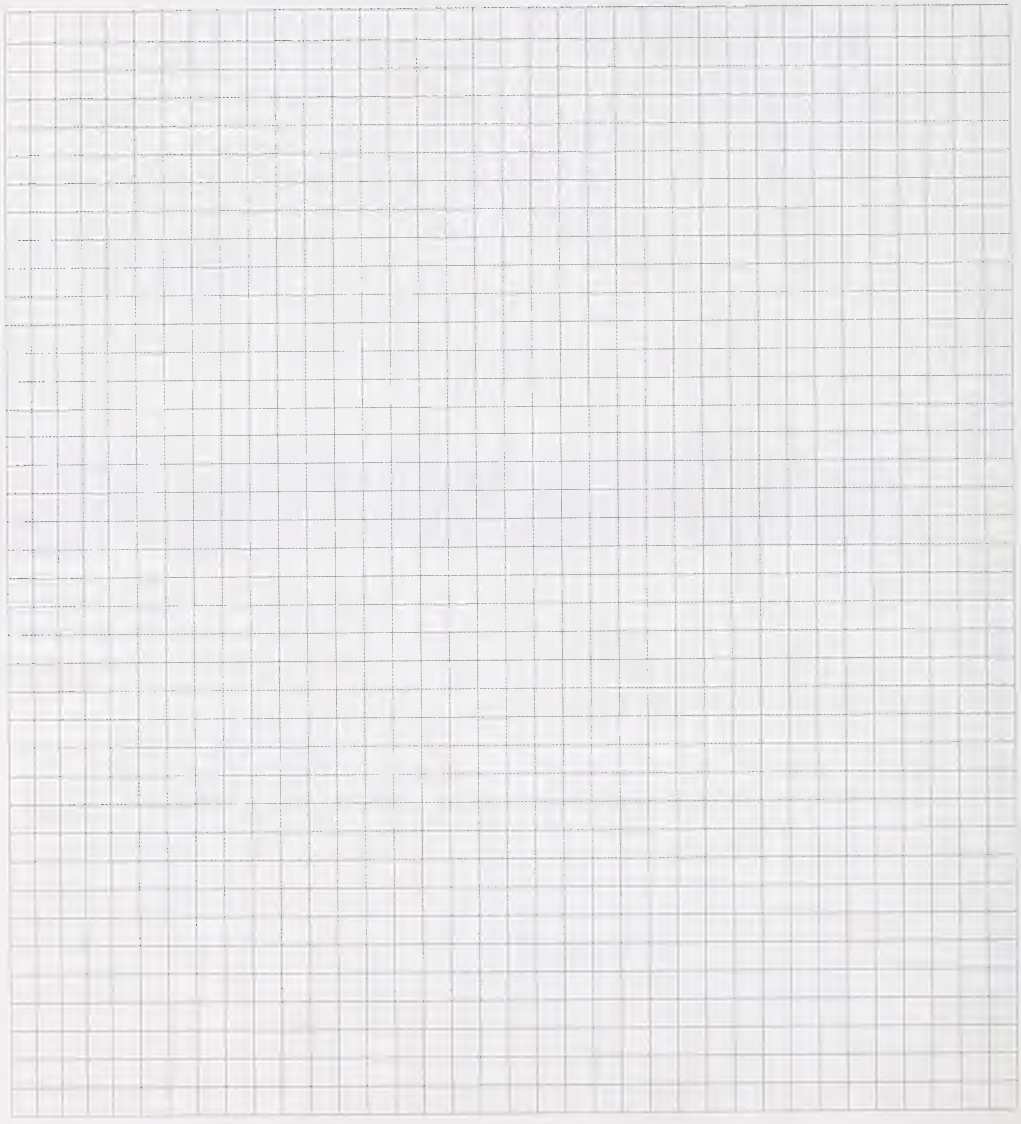
In column A the pattern is "add 4." In column B the pattern is "add 1."

Now complete the following table:

A	B
20	5
24	6
28	7
32	8
36	9

Go online to watch the Notepad Tutor about Extending Patterns without Concrete Materials.

- In your Workbook go to Unit 2, Lesson 1 and complete 1 to 24.



Lesson 2

Describing Patterns

Improvement in Keyboarding

Alyssa is taking a keyboarding class. Today she took a typing test to see how fast she could type. The chart below shows the number of words Alyssa typed after 1, 3, 5, and 7 minutes.

Alyssa's Test	
Time (in Minutes)	**Number of Words Typed**
1	32
3	96
5	160
7	224

You should be able to find patterns in the number of words typed from one minute to the next.

Reflection

Think about Alyssa's typing. What pattern do you find? Try to describe the pattern in your own words.

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Describe a given pattern
- Describe the relationship in a given table or chart, using a mathematical expression

Go online to watch the Notepad Tutor about Describing Number Patterns.

Describing Patterns in Words

After you study the elements or numbers in a pattern and determine the rule, you will need to describe it. Sometimes you will tell someone about the pattern. You may also need to write about the pattern. You will use phrases such as:

one more five more two less

You will use these words to describe patterns in charts, tables and other activities. Here is an example.

Example 1

You have been asked to describe the following pattern:

1, 4, 7, 10, 13, 16

Ask yourself questions like the following:

1. Is the pattern increasing or decreasing?

   The pattern starts with 1 and goes to 16. It is increasing.

2. Can you add a number to the first to get the second? If yes, what number?

   You can add 3 to 1 to get 4.

3. Can you add 3 to the next number and so on?

   Yes. The pattern works when you add 3 to each element.

4. Now, describe the pattern out loud and then in writing.

   You could say: "each number is 3 more than the previous number"

   You could write: "add 3"

Let's Explore

Exploration 1: Number Patterns

Materials: Unit 2, Lesson 2, Exploration 1 page from your Workbook, Pencil

Can you describe the pattern between Column A to Column B in the following chart?

A	B
10	8
8	6
6	4
4	2
2	0

1. Is the pattern increasing or decreasing from Column A to Column B?
2. Can you subtract a number from the first to get the second? If yes, what number?
3. Now, describe the pattern out loud and also in writing.

Let's Practice

- In your Workbook go to Unit 2, Lesson 2 and complete 1 to 10.

Mathematical Expressions

You will need to describe the **relationship** between the elements of a chart or table using a **mathematical expression**. An expression is a mathematical sentence that contains operations of numbers and **variables**.

Many years ago in India the people used symbols rather than numerals to represent numbers. Their symbol for 4 was:

= 4

Math teachers and textbooks use symbols to represent numbers all of the time. When you use letters it can make it faster to write the math.

A mathematical expression shows how the elements of a chart or table are connected. You should remember using symbols like this:

☐ + 5

In this expression, the ☐ is the unknown. Now you are ready for a new type of unknown. It is called a variable. A variable is a letter that represents an unknown value. You can use variables to make writing your problems easier. Here are some variable expressions:

h + 4 n − 5 x + 2 7 + p

This type of expression may be used to describe relationships in tables. Here's an example.

Example 2

Here is a table with two columns of numbers.

n	□
15	18
20	23
25	28
30	33
35	38

Here is one way to find the mathematical expression for this table:

1. Look at the elements in both columns.
2. Look across each row to see if you can find the pattern.
3. What pattern do you find?

   In each row you should see that each element in the second column is 3 more than the element in the **n** column

4. Can you add a number to the first to get the second? If yes, what number?

   Yes, you can add 3.

5. Describe the pattern.

   You will add 3 to the column labelled n to get the value in the second column.

The relationship between the elements in the table is shown here:

n	Rule	n + 3
15	15 + 3 =	18
20	20 + 3 =	23
25	25 + 3 =	28
30	30 + 3 =	33
35	35 + 3 =	38

Now you can write a mathematical expression that illustrates the rule.

The variable stands for all elements in the first column: n

The rule is "add 3" so the operation is: + 3

Put that together, and the answer is: n + 3

Let's Explore

Exploration 2: Mathematical Expressions

Materials: Unit 2, Lesson 2, Exploration 2 page from your Workbook, Pencil

Can you write a mathematical expression to describe the relationship between n and its corresponding element?

n	Rule	□
40		33
30		23
20		13
10		3

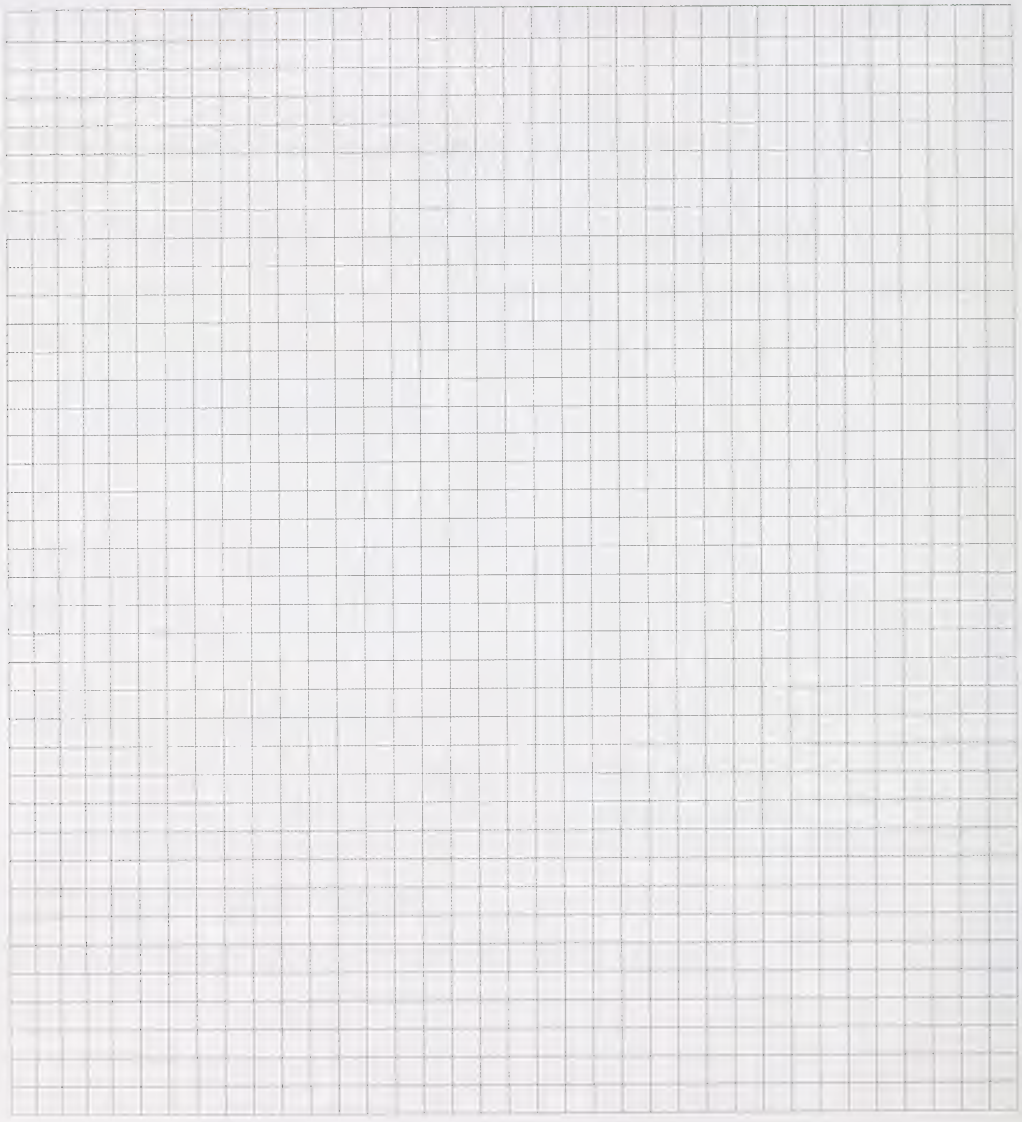
Here are some questions to answer:

1. What pattern do you find when you look across each row?
2. Can you subtract from each number to get the next? If yes, what number?
3. What is the rule for this table?
4. What is the mathematical expression for this table?

Let's Practice

Go online to complete the Concept Capsule about Describing Patterns.

- In your Workbook go to Unit 2, Lesson 2 and complete 11 to 15.



Lesson 3

Pattern Rules

Honey Production

Do you remember the picture of the honeycomb in Lesson 1?

It turns out that Daksha's uncle is a beekeeper. He produces honey using his beehives and measures it by the litre. He knows how much honey he will make each month based on the number of hives.

Honey Production

Number of Hives	3	5	7	9	11	13
Litres of Honey	6	10	14	18	22	26

You can look for patterns in tables like this to make a rule. The rule for the relationship of hives to honey is number of hives times 2. This lesson will help you find these types of rules and write an expression for the rule.

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Determine the pattern rule
- Write a mathematical expression for a pattern

Pattern Rules

You will remember from previous lessons that a pattern can help solve problems. There are certain steps to discovering a pattern.

Patterns are a series or sequence of numbers or elements that follow a rule. The pattern may occur as a rule to get from one element to the next:

It may also be a rule that relates two values in a table:

A	Rule	B
4	4 x 3	12
5	5 x 3	15
6	6 x 3	18
7	7 x 3	21
8	8 x 3	24

Once you find the rule you can describe it using words or mathematical expressions.

The rule that relates **A** to **B** is:

A x 3

Finding a Rule

In tables, a rule **relates** the first set of numbers to the second set of numbers. You can find rules by looking for an **operation** across the row.

A	B
1	8
2	9
3	10
4	11
5	12

This table shows the relationship between **A** and **B**:

A	Rule	B
1	1 + 7	8
2	2 + 7	9
3	3 + 7	10
4	4 + 7	11
5	5 + 7	12

The rule that relates **A** to **B** is:

A + 7

The operation is addition. The number you add to each element of **A** to get the element of **B** is 7.

You can use patterns in the second column to find the rule that relates **A** to **B**. This works if the pattern in Column **A** is to add 1.

A pattern of adding a number greater than one each time, down a column like this...

A	B
3	6
4	8
5	10
6	12
7	14

+2 +2 +2 +2

Becomes

A	Rule	B
3	3 x 2	6
4	4 x 2	8
5	5 x 2	10
6	6 x 2	12
7	7 x 2	14

...translates to multiplication across a row. In this case adding 2 down Column B is the same as multiplying by 2 across the rows. Adding 3 is the same as multiplying by 3. The rule that relates **A** to **B** in this example is:

A x 2

If the pattern is add 1 down the column...

A	B
8	4
9	5
10	6
11	7
12	8

+1 +1 +1 +1

Becomes

A	Rule	B
8	8 – 4 =	4
9	9 – 4 =	5
10	10 – 4 =	6
11	11 – 4 =	7
12	12 – 4 =	8

...try adding or subtracting across the row.

In Column B, adding one to get the pattern means there will be no multiplication. To find the rule you can guess-and-test until you find the number that you will add or subtract across the rows. You can also look for the difference. In this example the rule that relates **A** to **B** is:

A – 4

Here's an example.

Example 1

What is a mathematical expression that shows the relationship between **A** and **B** in the following table?

A	B
3	18
4	24
5	30
6	36
7	42

Here is one way to solve this problem.

1. What is the pattern in column B?

   add 6 ← This tells you that your rule should be multiply by 6.

2. Can you multiply 3 by 6 to get 18?

   $3 \times 6 = 18$ Yes.

3. Does this work for the next pairs? Now, let's test this idea in a table:

A	Rule	B
3	3 x 6 =	18
4	4 x 6 =	24
5	5 x 6 =	30
6	6 x 6 =	36
7	7 x 6 =	42

4. Did it work? What's the mathematical expression for the rule?

   The rule to find B is: A x 6

Exploration 1: Mathematical Expressions

Materials: Unit 2, Lesson 3, Exploration 1 page from your Workbook, Pencil

Can you write a mathematical expression to show the relationship between A and B?

A	B
4	12
5	13
6	14
7	15
8	16

1. What is the pattern in Column B?
2. What operation can you perform on 4 to get 12?
3. Does this work for every pair?
4. What is the mathematical expression to show the relationship between A and B?

Here is another example to help you with your understanding.

Example 2

Can you find the rule that relates A to B in the following table?

A	B
16	21
17	22
18	23
19	24
20	25

Here is one way to solve this problem.

1. Ask yourself: What is the pattern of Column B?

   Add 1. ←

   This should tell you that you will add or subtract to find your rule.

2. Is the value in each row increasing or decreasing?

   The first row starts with 16 in **A** and goes to 21 in **B**.

   This is increasing. The rule is to add a number.

3. What number do you add to 16 to get 21?

   You add 5 to 16 to get 21.

Can you add 5 to the next number and so on? If you think so, test adding 5 in a table like this:

A	Rule	B
16	16 + 5 =	21
17	17 + 5 =	22
18	18 + 5 =	23
19	19 + 5 =	24
20	20 + 5 =	25

Yes – the rule works for all elements of **B**.

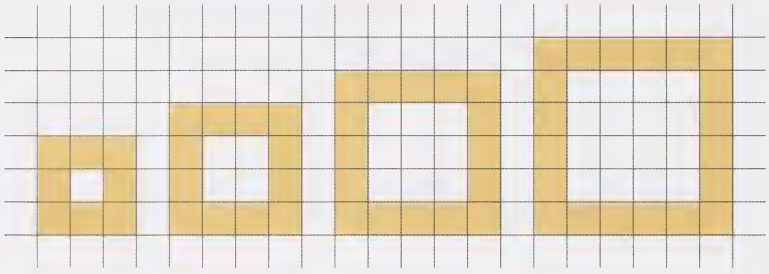
Describe the pattern using a variable in a mathematical expression.

A + 5

Let's Explore

Exploration 2: Doughnut Pattern

Materials: Unit 2, Lesson 3, Exploration 2 page from your Workbook, Grid Paper from the back of this Unit in your Workbook, Pencil, Paper



1. On your grid paper, create the doughnut pattern shown here. Label each figure with the number of shaded squares.
2. What is the pattern for the number of shaded squares?
3. Can you add the same number to the figure number to get the number of shaded squares? Why or why not?
4. Can you find another way to get the number of shaded squares from the figure number using number operations?
5. Describe the relationship between the figure number and the number of shaded squares in words and with a rule. Write your rule as an expression.

6. Extend the pattern for the next five possible figures. You can do this without creating the shapes if you figured out the pattern.

Figure Number	1	2	3	4	5	6	7	8
Number of Shaded Squares	8	12	16	20				

A rule may require more than one step. You can find these rules by problem solving. Here is an example of a two-step pattern rule.

Example 3 (Enrichment: A two-step rule)

What is the rule that relates **A** to **B** in the following table?

A	B
1	5
2	9
3	13
4	17
5	21
6	25

Here is one way to solve this problem.

1. What is the pattern in column **B**?

   Add 4. ←

This tells you that you will multiply by 4 to find your rule.

2. Can you multiply 1 by 4 and get 5?

   1 x 4 ≠ 5. No.

   Oh, no! So now what?

3. What is 1 x 4? 1 x 4 = 4

   How close is that to 5? 4 + 1 = 5

That is a two-step rule. Let's see if it works.

Test the rule with the rest of the terms: x 4 and + 1

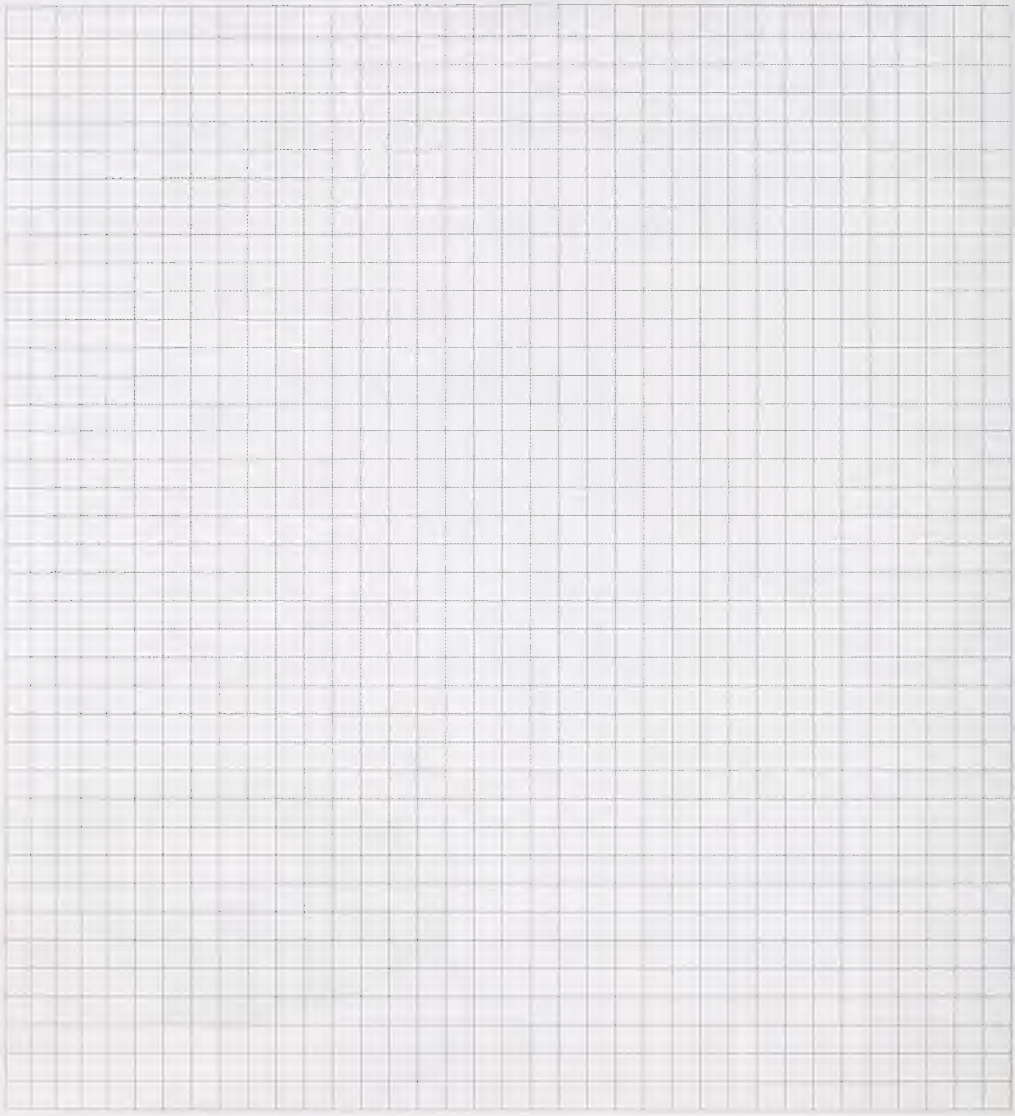
A	Rule	B
1	1 x 4 = 4 + 1 =	5
2	2 x 4 = 8 + 1 =	9
3	3 x 4 = 12 + 1 =	13
4	4 x 4 = 16 + 1 =	17
5	5 x 4 = 20 + 1 =	21
6	6 x 4 = 24 + 1 =	25

The rule to find **B** is: A x 4 + 1

Let's Practice

Go online and complete the Concept Capsule about Pattern Rules.

- In your Workbook go to Unit 2, Lesson 3 and complete 1 to 15.



Lesson 4

Making Predictions

People Patterns

Skydivers can join hands to create patterns in the sky as they fall. One of these patterns is formed by linking groups of three divers as shown and then connecting them to the centre group.

You can make a table to show the number of skydivers. This table shows a pattern in the number of skydivers.

Figure Number	Number of Skydivers
1	3
2	6
3	9
4	12

Patterns are all around you. You can find them in your home, in nature and in the things you do. You can use patterns to help solve problems.

Reflection

How can you use the pattern to predict the number of skydivers in the 10th figure?

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Represent a pattern visually to verify predictions
- Predict subsequent elements in a given pattern
- Solve a given problem by using a pattern rule to determine subsequent elements

Visual Representations

You can use visual representations or pictures to make a pattern that describes a problem.

One way to do this is to use dots to form triangles. These triangles represent the numbers.

Triangle Number	Number of Dots
1	1
2	3
3	6
4	10

The figures here have been created using dots. Each triangle is formed by adding another row to the triangle. The picture helps you to see the pattern in the numbers.

You can create pictures of the pattern using any figure you want. It is best to use items that are easy for you to draw. You may need to organize them in ways that allow you to see the pattern easily.

Here's an example.

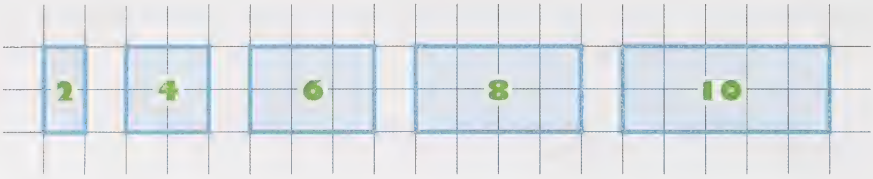
Example 1

Is the 10th element in the pattern 24?

A	B
1	2
2	4
3	6
4	8
5	10

Let's create a model for the pattern in the following table.

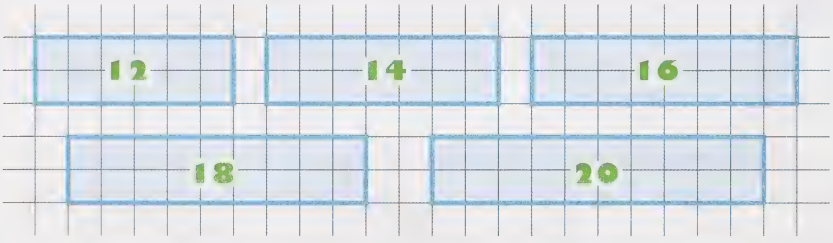
Create the pattern in Column B of the table using grid paper. You can find grid paper at the back of this Unit in your Workbook.



This arrangement is using arrays. Each array is the element number in **A** along the base. The height of each is 2 which is the number you add each time.

You can use different strategies to find the answer. Here are a couple:

Strategy 1: Continue the pattern on grid paper:

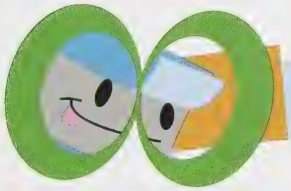


You will find that the 10th figure is not 24. It is 20.

Strategy 2: Use the pattern you created to predict the answer.
Adding 2, five more times:

10 + 2 = 12	12 + 2 = 14	14 + 2 = 16	16 + 2 = 18	18 + 2 = 20
Element 6	Element 7	Element 8	Element 9	Element 10

No – the 10th element is not 24.



Let's Explore

Exploration 1: Pattern Prediction

Materials: Unit 2, Lesson 4, Exploration 1 page from your Workbook, Cubes or your Square Counters, Paper, Pencil

1. Create the fourth figure of this pattern using your materials.
2. Describe how you created the fourth figure.
3. Describe how you would create the fifth figure without using your materials.
4. How many squares will be in the tenth figure of the pattern?
5. Explain how you predicted the tenth figure of the pattern.

Predicting Elements

You can use picture models to predict a pattern. Organize your models in a way that helps you to see the elements of a table or **sequence**. This will help you make predictions and write rules.

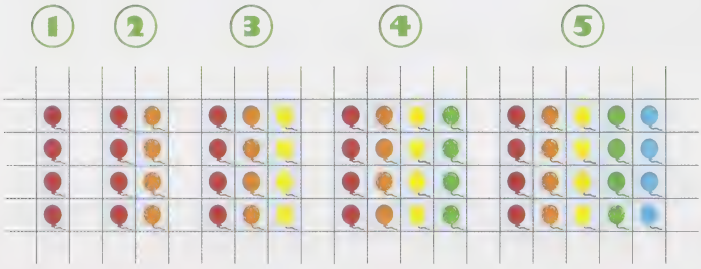
Example 2

The fifth grade classes are having a party. Mrs. Perkins is in charge of the balloons. She has several bunches of balloons that she will place at each table. There are 4 balloons in each bunch. Predict the number of balloons for 8 tables, if she places one bunch at each table.

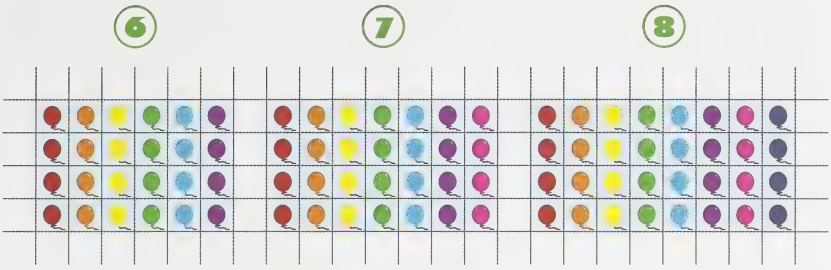
Number of Tables	Number of Balloons
1	4
2	8
3	12
4	16
5	20

Here is one way to solve this problem.

1. Create the model using grid paper:



2. Create the 6th, 7th then 8th elements using grid paper:



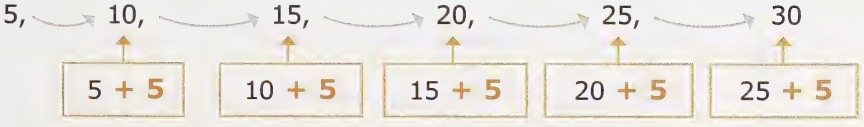
The eighth term is 32.
There will be 32 balloons on 8 tables.

Using Rules to Predict

Rules can work in two ways. They can relate one element to the next in a sequence:

5, 10, 15, 20, 25, 30

If n is the first term, the second term is n + 5.



They can also relate one value to another in a chart or table:

A	1	2	3	4	5	6
B	5	6	7	8	9	10

The rule is **A** + 4 = **B**.

A	1	2	3	4	5	6
Rule	1 + 4	2 + 4	3 + 4	4 + 4	5 + 4	6 + 4
B	5	6	7	8	9	10

Once you have found the rule, you can use it to find a future element in the pattern.

Here's an example.

Example 3

Use rules to predict the eighth element of the sequence.

A	B
1	4
2	8
3	12
4	16
5	20

a. Use the rule for Column B

b. Use the rule that relates **A** to **B**

Here is one way to solve this problem.

a. Use the rule for Column B: add 4

$20 + 4 = 24$ (Element 6) $\quad 24 + 4 = 28$ (Element 7) $\quad 28 + 4 = 32$ (Element 8)

This rule is fine when there are only a few more elements to find.

b. Use the rule that relates **A** to **B**:

A	Rule	B
1	1 x 4	4
2	2 x 4	8
3	3 x 4	12
4	4 x 4	16
5	5 x 4	20

The rule is A x 4 = B, so the 8th element is 8 x 4 = 32

This method works best when you are trying to predict really large elements.

Let's Explore

Exploration 2: Car Wash

Materials: Unit 2, Lesson 4, Exploration 2 page from your Workbook, Pencil

Lian's school is having a car wash. Each student is given a book of tickets as shown in the table. How many tickets are there in 100 books?

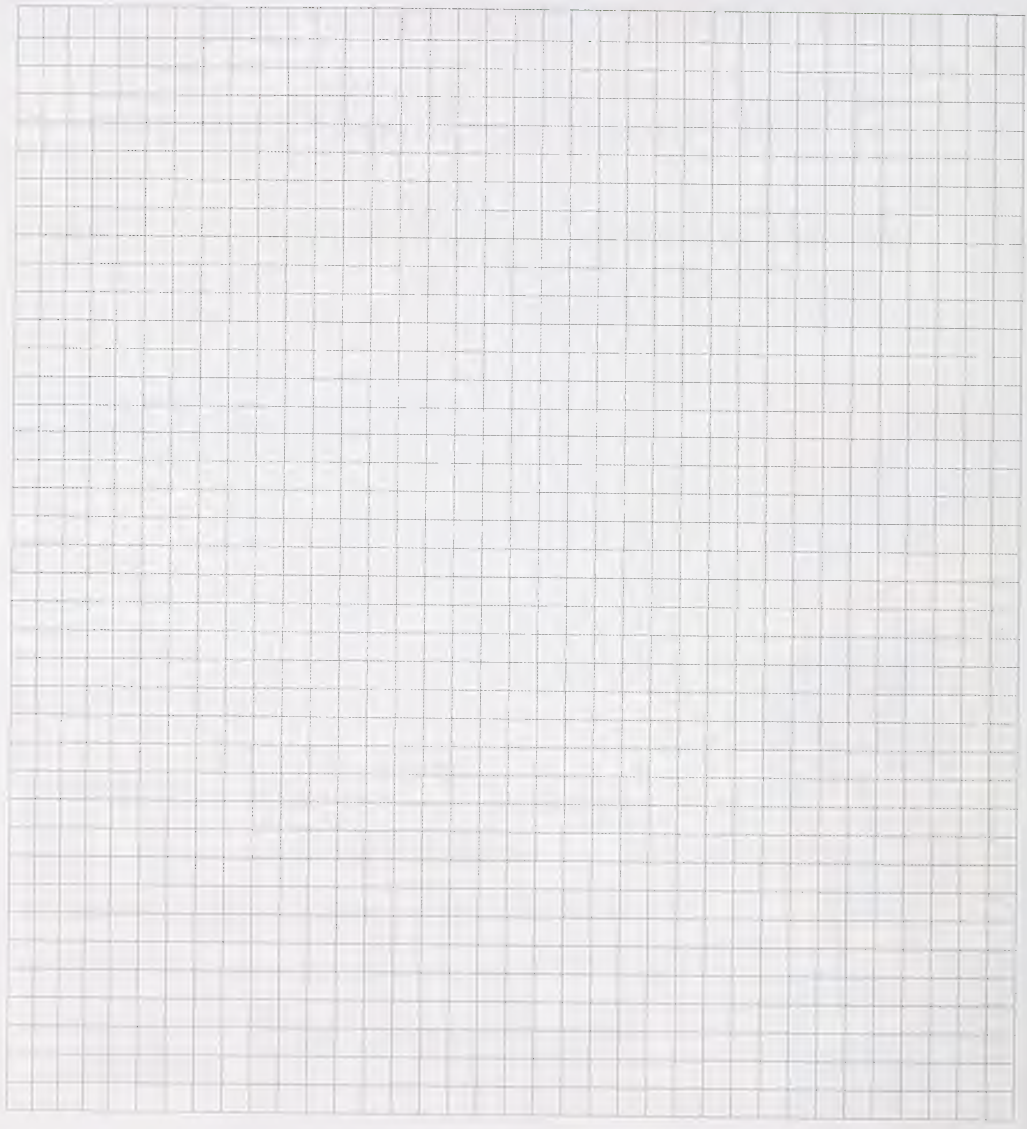
Number of Books	Number of Tickets
1	5
2	10
3	15
4	20
5	25

1. What pattern do you see?
2. What can you multiply 1 by to get 5?
3. Does that rule work for the rest of the elements?
4. Predict how many tickets there are in 100 books?
5. Describe in words how you found your answer to number 4.

Let's Practice

- In your Workbook go to Unit 2, Lesson 4 and complete 1 to 17.

Go online to watch the Notepad Tutor about Making Predictions.



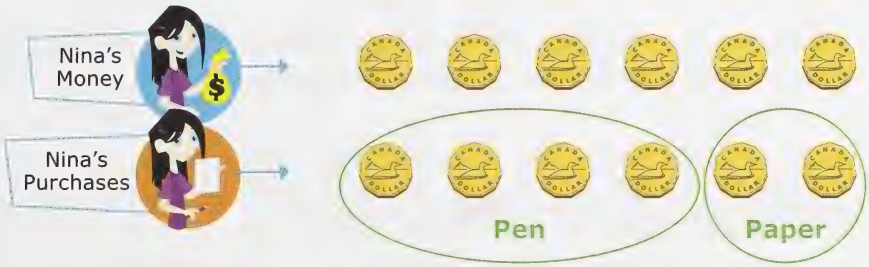
Lesson 5

Addition Equations

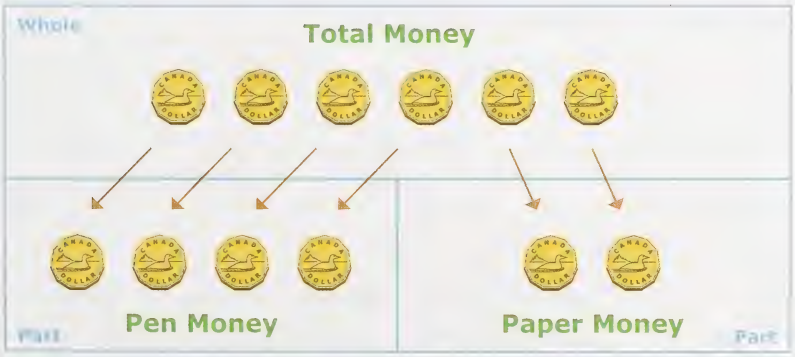
Money Matters

You have probably had money given to you to purchase items that you need. Buying school supplies for your studies is one example of when you will have to spend money.

Nina bought a pen for $4 and some paper for $2. Nina spent a total of $6.



Maybe you remember part-whole models? If you put Nina's problem in a part-whole model it looks like this:



Part + Part = Whole

Nina's pen money and her paper money are the parts that make up all of her money. The value of the whole is the same as the value of the parts combined. This model can help you solve part-whole problems.

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Write a variable for a given unknown
- Solve a given single-variable addition equation with the given unknown
- Solve problems involving one-step equations

Go online to complete the Concept Capsule about Problem Solving Using Concrete Models (Adding and Subtracting).

Variables and Part-Whole Models

You should remember solving **equations** that look like this:

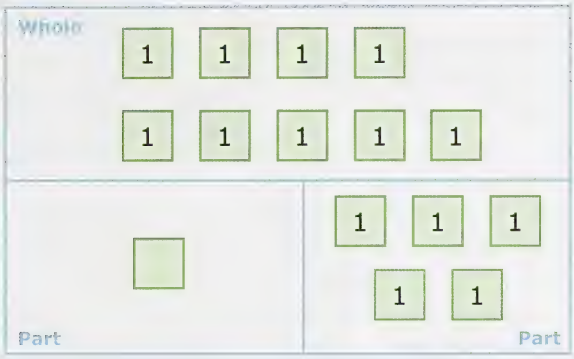
$\square + 5 = 9$

To solve this you may have thought:

What number plus five is equal to nine?

You may have created a model instead. Counters or pictures can be used for models. See the part-part-whole model here:

$\square + 5 = 9$



In this equation, the $\square$ is the unknown. You must find the number that can replace the unknown. What number will make the sentence true? How many ones can you replace the $\square$ with to create two parts that equal the whole?

Now you are ready for a new type of unknown. It is called a variable. A variable is a letter that represents an unknown value. You can use variables to make writing your problems easier.

$\square + 5 = 9$ becomes $x + 5 = 9$

It doesn't matter what variable you choose.
Here are some equations with variables:

$a + 7 = 15$ $4 + n = 8$ $p + 12 = 67$ $q + 9 = 25$

It doesn't matter what letter you use for the variable.
The unknown is still the part you are trying to find.

Solving Addition Equations

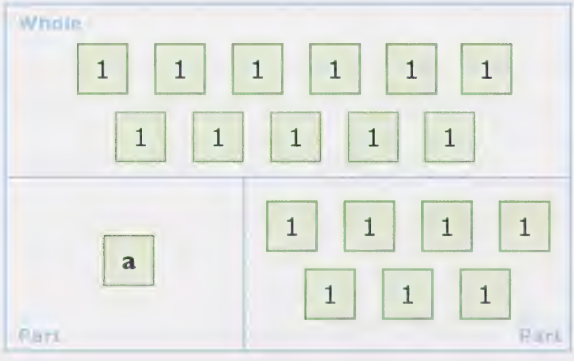
An addition equation has two parts. One side has an addition sentence that includes a variable. The other side has the total quantity. You can still use models to solve equations. Find the Part-Whole Mat and Algebra Tiles that are found at the back of this Unit in your Workbook. Cut out the Algebra Tiles. Create each equation.

Example 1

Solve a + 7 = 11

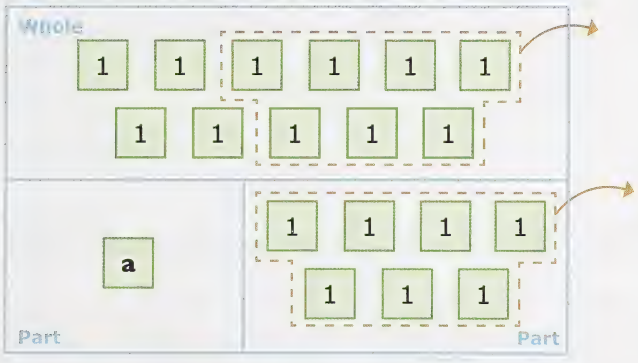
First, model the equation using a part-whole mat and algebra tiles.

The two parts must equal the whole. We have 11 in the whole and 7 in the part that has ones. The unknown is in the other part.



Next, ask yourself "How many ones are needed in the unknown part to equal 11?"

Match ones in the part to the same number of ones in the whole. Now remove these from the mat.



These match up so they are not part of the solution. The four that are left show us the amount for **a**.

Transfer what you found to the solution: **a = 4**

Now It's Your Turn

Model the equations on part-whole mats on your desk. Use algebra tiles to create the models. Solve the following.

a. $a + 3 = 8$ b. $x + 6 = 10$ c. $m + 4 = 6$ d. $p + 1 = 7$

Solutions

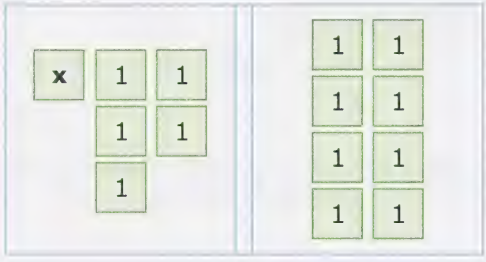
a. a = 5 b. x = 4 c. m = 2 d. p = 6

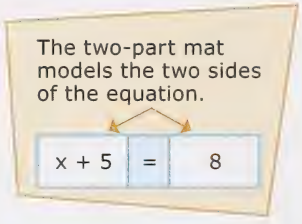
Another way to model equations would be a two-part mat and your algebra tiles. It is like a part-whole mat. A two-part mat has two spaces rather than three. Below is an equation solved using a two-part mat.

Example 2

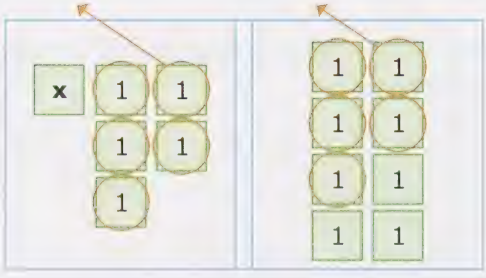
Solve x + 5 = 8

Model the equation using algebra tiles.





Take away pairs of ones tiles from both sides until only the x remains.



The **remainder** amount of tiles on the side opposite the x is the answer.

The solution is: x = 3

Solving Equations Using Guess-and-Test

You can solve addition equations in your head. Guess-and-test means make a guess for the unknown, and test this number in the equation.

Example 3

Solve a + 8 = 12.

Think: What number plus 8 equals 12?

Guess: a number, for example 5

Test: Check your number:

5 + 8 = 13 ✗

This answer is too high. Try again with a lower number.

Guess: this time 4

4 + 8 = 12 ✓

The solution is: a = 4

Solving Equations Using Rules

You may have noticed patterns in solving equations. Let's explore those patterns through this experiment.

Exploration 1: Solving Addition Equations

Materials: Unit 2, Lesson 5, Exploration 1 page from your Workbook, Two-Part Mat and Algebra Tiles, both from the back of this Unit in your Workbook, Paper, Pencil

1. Model the equation $x + 5 = 8$ and solve. Describe the process to a neighbour.
2. Model the equation $x + 4 = 10$ and solve. Describe the process to a neighbour.
3. Model the equation $x + 7 = 15$. Do NOT solve. Describe in writing what you should do to solve the equation.
4. Complete the following statement: To solve the equation $x + 5 = 9$ with algebra tiles I would _____ 5 ones tiles from each side.
5. How many tiles would you have to remove from both sides of the mat to solve $m + 7 = 10$?
6. What operation would you use to describe the removing of the tiles from both sides of the equation?

The Rule for Solving Addition Equations

To solve an addition equation, ___?___ the number added to the variable from each side of the equation.

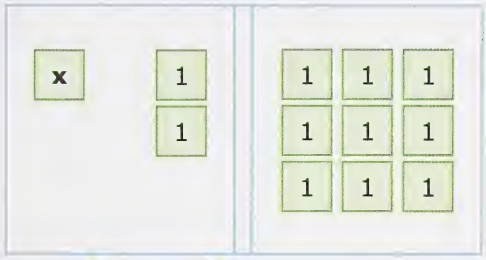
The **inverse** operation of addition is subtraction. This means that by subtracting the same number from both sides of an equation you get the part you need. The subtractive equation **property** allows you to use this rule.

Subtractive Equation Property

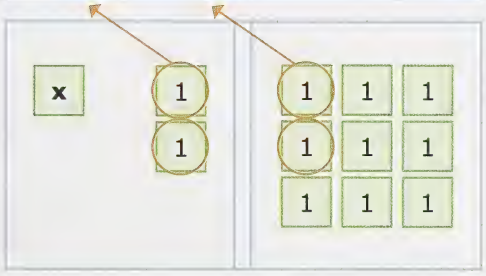
The two sides of an equation remain equal if the same number is subtracted from each side.

Here is how the rule relates the equation to the model.

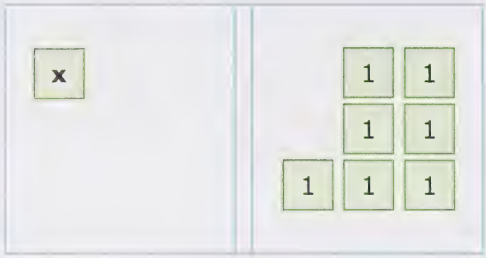
$x + 2 = 9$



$x + 2 - 2 = 9 - 2$



$x = 7$



Now let's use the rule to solve an equation. The model is shown at right.

Example 4

Solve: $a + 4 = 12$

Using rule only

Write the equation.

$x + 4 = 12$

Subtract the number added to the variable from both sides.

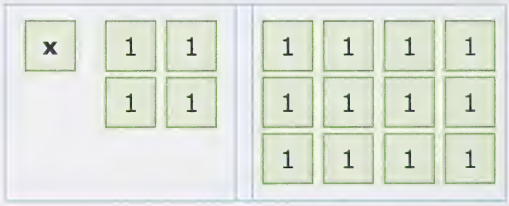
$x + 4 - 4 = 12 - 4$

The solution is:

$x = 8$

Modelling

Model of $x + 4 = 12$



How does all of this relate to you? Think of this situation:

Zach needs a total of 10 eggs to make his awesome brownies. He has 3 eggs. How many more eggs does Zach need?

The situation is: Some number of eggs plus 3 eggs equals 10 eggs.

Part + Part = Whole

The missing part represents the unknown. When a part is missing it is an addition equation.

Example 5

Solve: n + 3 = 10

Using rule only

Write the equation.

n + 3 = 10

Subtract the number added to the variable from both sides.

n + 3 – 3 = 10 – 3

The solution is:

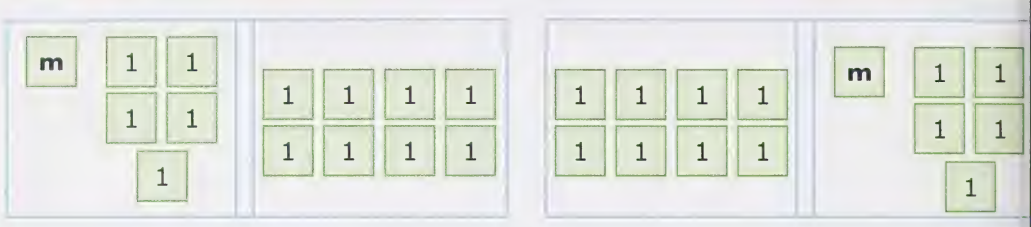
n = 7

The Variable in Different Positions

The variable may appear on the other side of the equation. It does not change the meaning of an equation if the variable is on a different side. Solving addition equations in this form will involve the same steps and rules.

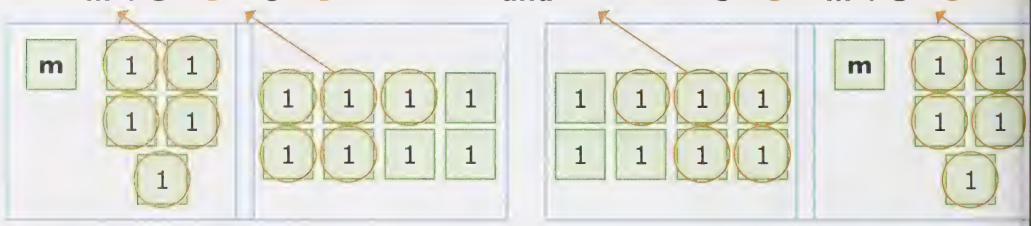
The equation and model:

m + 5 = 8 and **8 = m + 5**



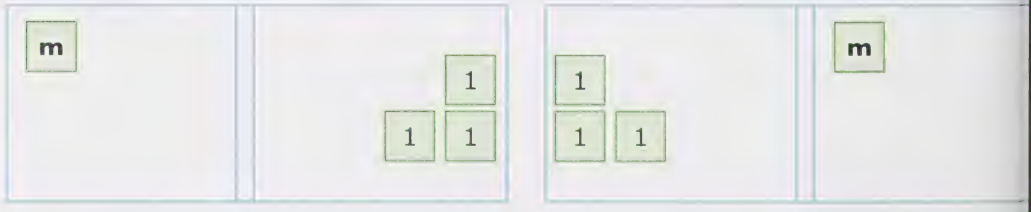
Subtract 5 from each side:

m + 5 – 5 = 8 – 5 and **8 – 5 = m + 5 – 5**



The answer is:

m = 3 and **3 = m**



You may wonder: What is the difference?

One equation has the variable with the addition on the left. The other equation has the addition on the right. The answer m = 3 and 3 = m have the same meaning, as you saw in the model.

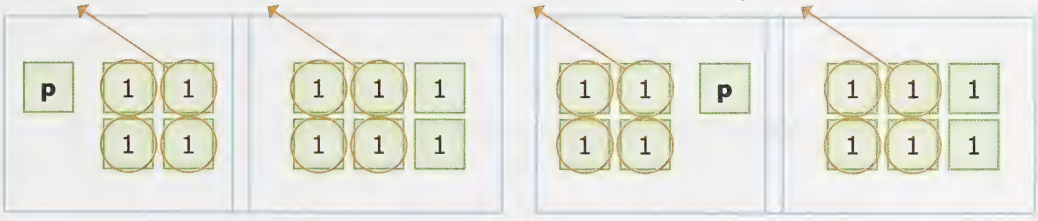
Variables may also be in a different position on a side of the equation. Notice that the rule and the model are still the same:

Model the equations:

p + 4 = 6 **and** **4 + p = 6**

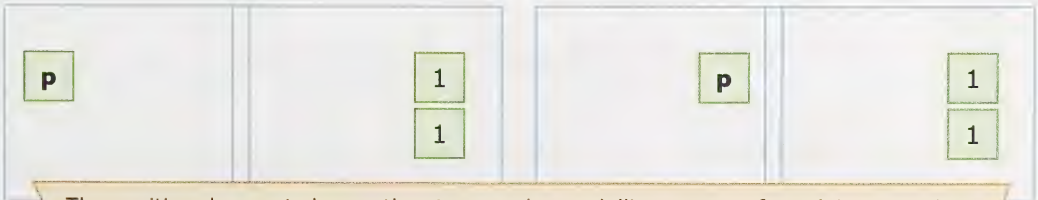
Subtract 4 from both sides:

p + 4 – 4 = 6 – 4 **and** **4 – 4 + p = 6 – 4**



The answer is:

p = 2 **and** **p = 2**



The position does not change the steps or the modelling process for solving equations.

Now It's Your Turn

Solve.

a. $b + 3 = 7$ b. $3 + m = 4$ c. $9 = 7 + q$ d. $8 = t + 4$

Solution

a. $b = 4$ b. $m = 1$ c. $2 = q$ d. $4 = t$

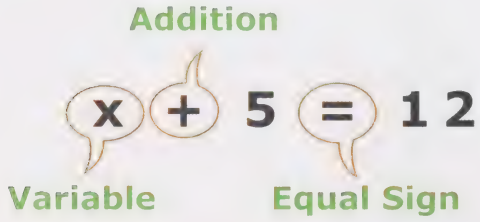
Let's Practice

- In your Workbook go to Unit 2, Lesson 5 and complete 1 to 26.

Writing Variable Equations

Words may be translated into variable equations. There are clue words that can tell you how to write an equation.

You should think about the parts of an addition equation:



You can use these clue words to write the parts of the equation:

Variable	Addition	Equal Sign
a number	sum	is
some number	and	equals
what number	plus	gives
how many	quantity	yields
	together	are
	more than	were
	total	will be

You can use these clue words to write equations.

Example 6

Write an equation for: the sum of a number and seven equals twelve

Circle the clue words:

the sum of a number and seven equals twelve

Write the numbers over the words:

7 12
the sum of a number and seven equals twelve

The operation of addition goes over the "and"

\+ 7 12
the sum of a number and seven equals twelve

Write a variable for "a number" and put the equal sign over "equals"

		x	+	7	=	12
the	sum	of	a number	and	seven	equals	twelve

Now write the equation:

x + 7 = 12

You may want to use your algebra tiles to help you write equations.

Example 7

Write an equation for: Some number of purses and three more purses yields twelve purses.

Use your algebra tiles to make a model of the sentence:

Write an equation for your model:

Part + Part = Whole

x + 3 = 12

Now It's Your Turn

Write an equation for each sentence.

a. some number plus eight is ten

b. the quantity of a number and six is ten

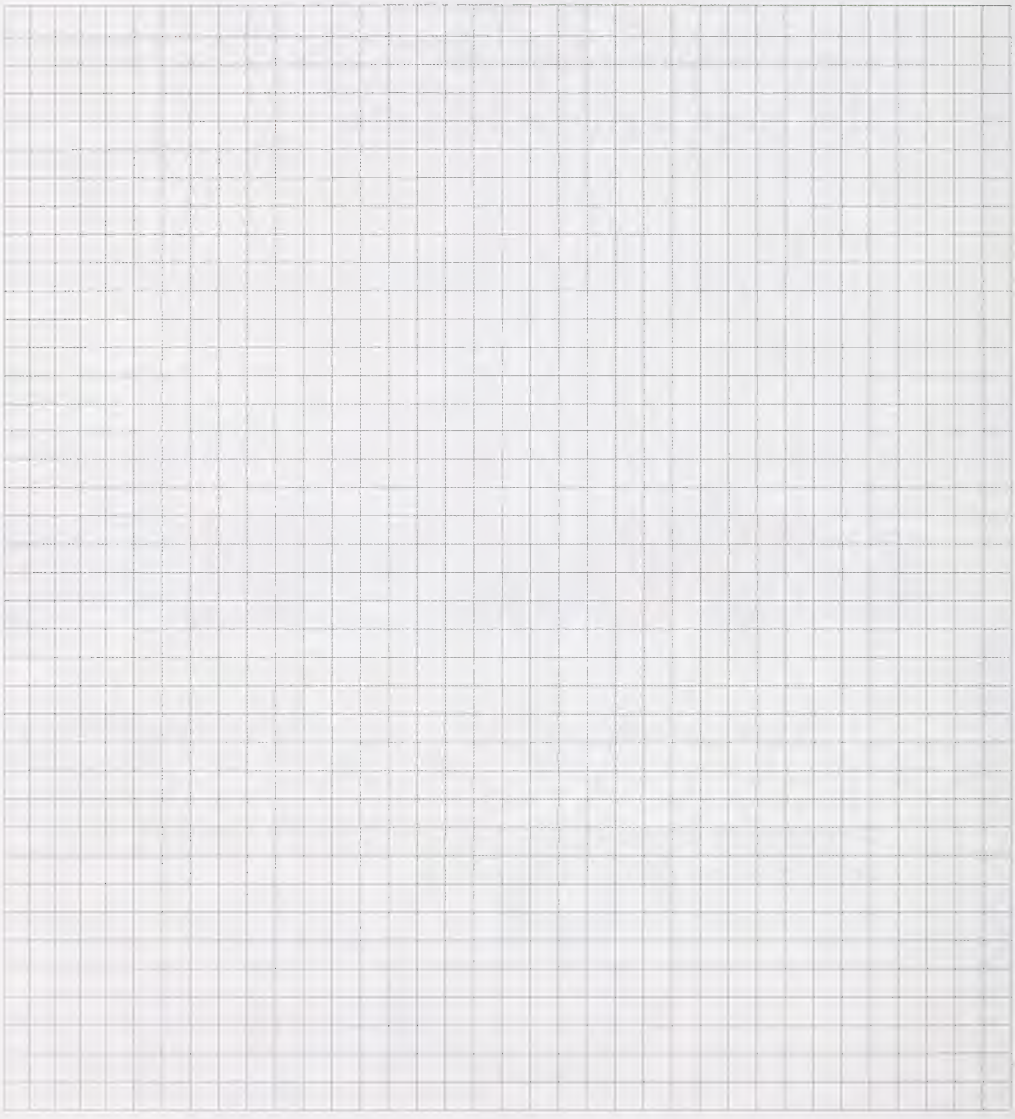
Solutions

a. $x + 8 = 10$

b. $n + 6 = 10$

- In your Workbook go to Unit 2, Lesson 5 and complete 27 to 37.

Go online to complete the Concept Capsule about Problem Solving Using Addition Equations.



Lesson 6

Subtraction Equations

Hockey Players

Canada's National Hockey team has won the World Championship 24 times from 1920 to 2008. The team has also won the gold medal at the Olympics 7 times since 1920.

Daksha is putting together a hockey team for his community league. He needs to have 6 players on the team. He has four players. This means he needs two more players.

You can make a part-whole model of the situation:

Whole - Part = Part

Using the part-whole model you can describe a subtraction equation.

You can write this equation as:

$6 - 2 = 4$ OR $6 - 4 = 2$

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Solve a given single-variable subtraction equation with an unknown
- Solve problems involving one-step equations

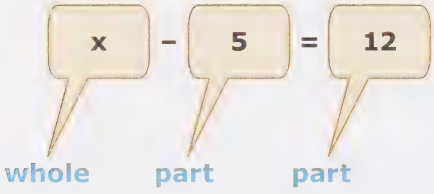
Solving Subtraction Equations

Here are some subtraction equations:

$x - 12 = 4$ $\qquad\qquad$ $9 = c - 3$

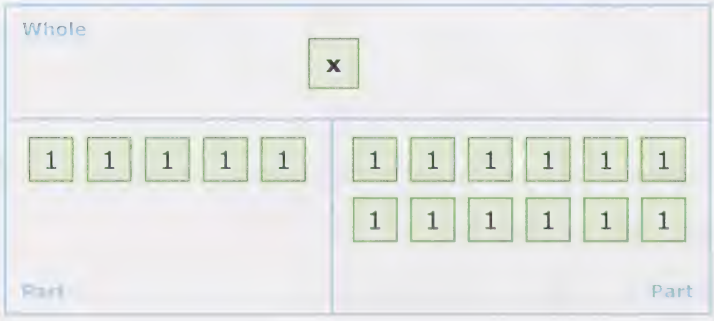
An equation must have an equal sign and an operation. For these equations the operation is subtraction.

The part-whole relationship of a subtraction equation is shown here:



You can use your algebra tiles to model the parts and the whole as shown.

$x - 5 = 12$

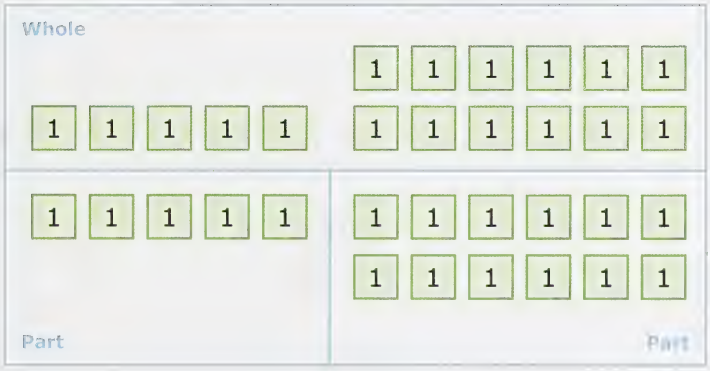


The whole is represented by the unknown in this equation. Remember, the whole is equal to the sum of the parts. To solve, ask yourself:

How many 1s belong in the whole section?

Since there are 5 and 12 in the parts, the whole is 17:

17 - 5 = 12



Simply replace the variable with the two parts combined to solve this type of equation.

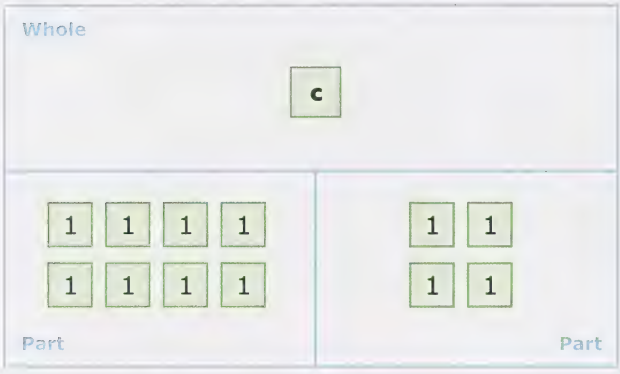
Let's explore by using your algebra tiles along with the following example.

Example 1

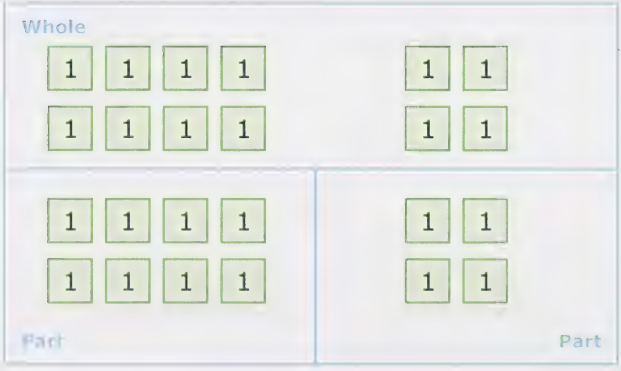
Solve c – 8 = 4

First, set up your part-whole model with the correct tiles. The variable is the whole and 8 and 4 are the parts.

c - 8 = 4



Now remove the variable tile. Replace with tiles to match the parts: 8 and 4.



Write the solution. It is c = followed by the number of tiles in the whole.

c = 12

Variable in Different Positions

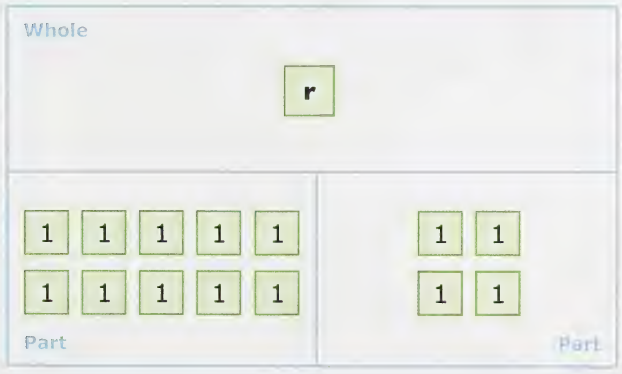
The variable may shift to the other side of the equation. Always start by identifying the parts and the whole. You can use a model to solve.

You should notice here that the whole is always the number that a number is being subtracted from.

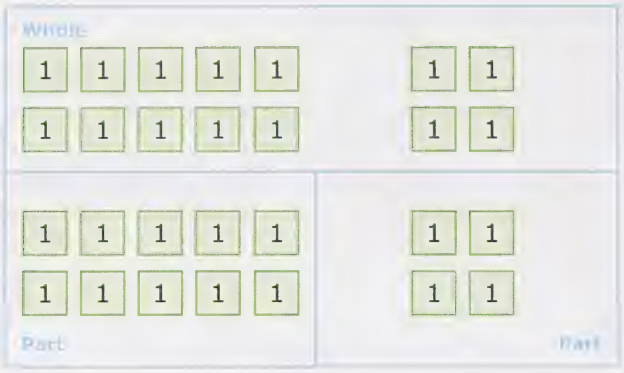
Example 2

Solve 10 = r – 4

Model the equation. The variable is still the whole even though it is on the other side.



Replace the variable with the tiles from the parts.



The variable is equal to the number of tiles in the whole.
r = 14

Relating to the Rule

There is a rule for solving a subtraction equation just like there is a rule for solving addition equations. Remember, to solve an addition equation you have to subtract the same number from both sides of the equation. What is the rule for subtraction equations?

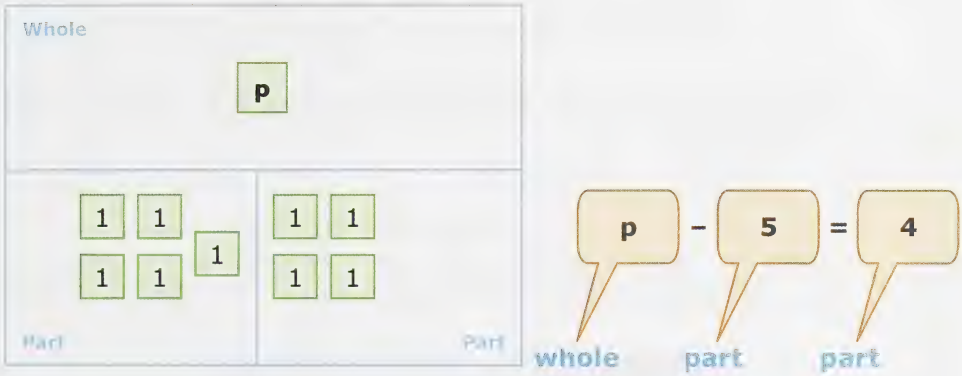
Notice how the operation relates to the variable as the whole:

Example 3

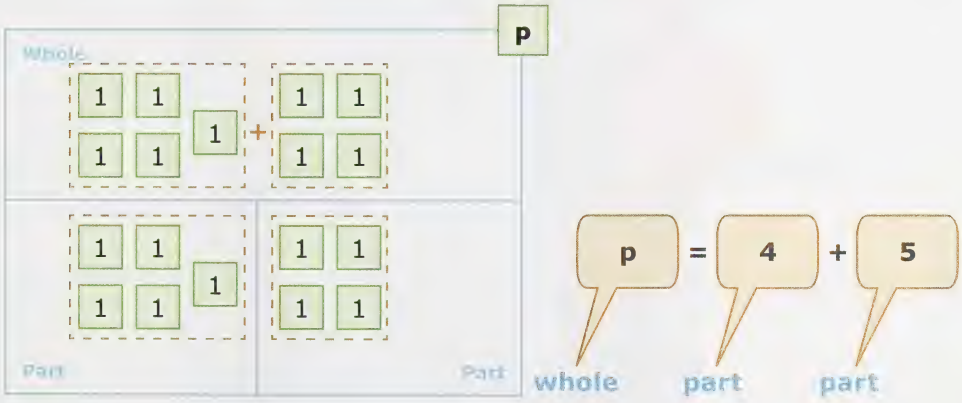
Solve p – 5 = 4

Relate the steps to mathematical operations as you model this equation.

Model the equation.



Notice that the part on the side by itself is 4. To get the whole you must add 5 to the four.



Write the solution found by adding the parts. p = 9

So what is the rule?

In a subtraction equation add the parts to get the whole. Another way of looking at this is the additive equation property.

Additive Equation Property
The two sides of an equation remain equal if the same number is added to each side.

Addition is the inverse operation of subtraction so it will "undo" the subtraction:

$k - 3 + 3 = k$

Think of it this way: If you owe your parents $3 and you give them $3 to pay them back, you are now even.

Let's Explore

Exploration 1: Rule for Subtraction Equations

Materials: Algebra tiles, part-whole mat, pencil, paper

Model the following equations on your mat and solve using the rule.

1. $x - 5 = 8$ 2. $h - 6 = 2$ 3. $k - 4 = 1$ 4. $m - 3 = 7$

5. Describe what you did to find the answer.

6. How does using the tiles help you understand the operation?

Example 4

Solve $m - 7 = 5$

First, copy the equation.

$m - 7 = 5$

Now, add the part on the subtraction side to both sides of the equation.

$m - 7 + 7 = 5 + 7$

Write the answer: $m = 12$

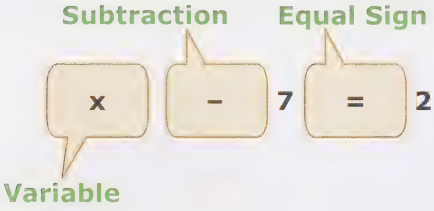
Let's Practice

- In your Workbook go to Unit 2, Lesson 6 and complete 1 to 18.

Writing Variable Equations

You have already written addition equations for sentences. There are clue words that can tell you how to write a subtraction equation.

Think about the parts of a subtraction equation:



These parts have various words that represent them:

Variable	Equal Sign	Subtraction
a number	is	less than
some number	equals	fewer than
what number	gives	reduced by
	yields	decreased by
	are	difference of
	were	
	will be	

You can use these clue words to write equations.

There are two clue words to be careful of in subtraction:

less than and fewer than

These words will prompt you to change the order of the numbers:

Words	Expression
5 less than x	x - 5
2 fewer than n	n - 2

Study the sample word sentences translated into equations:

Words	Equations
12 less than a number is 18	n - 12 = 18
7 fewer than a number equals 10	x - 7 = 10
some number decreased by 8 is 11	m - 8 = 11
the difference of a number and 2 is 6	h - 2 = 6
8 more than a number is 10	j + 8 = 10
the sum of a number yields 12	c + 6 = 12

The following examples are ways to change word sentences to equations.

Example 5

Write an equation for: seven less than a number equals twelve

To write your equation, do the following in order:

1. Circle clue words:

   seven less than a number equals twelve

2. Write numbers over their words:

   7 12
   seven less than a number equals twelve

3. Write a variable for "a number" and put the equal sign over "equals"

   7 x = 12
   seven less than a number equals twelve

4. The operation of subtraction is indicated by 'less than' but you must remember to change the order:

   7 x = 12
   seven less than a number equals twelve

   x - 7

5. Now write the equation:

   x – 7 = 12

You could also use algebra tiles to help you write sentences.

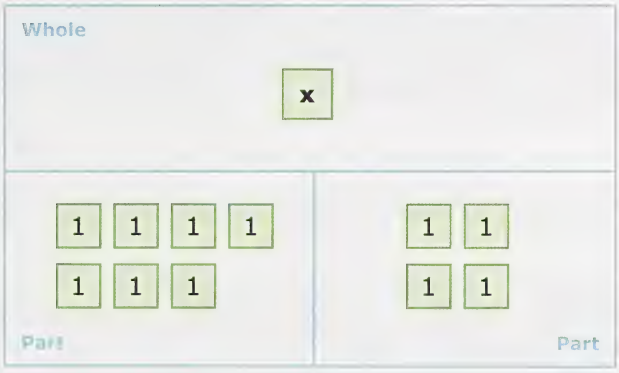
Example 6

Write an equation for the sentence:

"Some number reduced by seven is four."

Use a part-whole model and your algebra tiles to make a model.

Whole – Part = Part



Write the equation for the model.

x – 7 = 4

Now It's Your Turn

Write an equation for each sentence.

a. some number minus eight is ten

b. 10 equals the difference of a number and 6

Solutions

a. $x - 8 = 10$

b. $10 = n - 6$

Let's Practice

- In your Workbook go to Unit 2, Lesson 6 and complete 19 to 31.

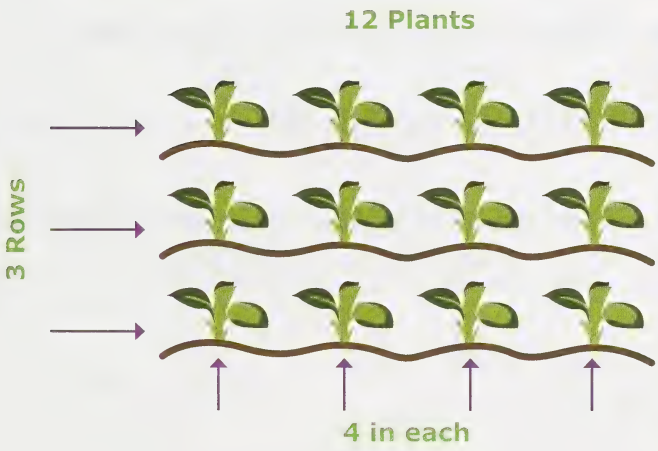
Go online to watch the Notepad Tutor about Problem Solving Using Subtraction Equations.

Lesson 7

Multiplication Equations

Gardening

Lian's family likes to grow their own vegetables. Lian needs to plant 12 bean plants in 3 rows in the family garden. The same number of plants must be in each row. This means that she will need to put 4 plants in each row.



This problem involves breaking up the 12 plants into 3 equal parts. Breaking the problem into parts is what you do when solving multiplication equations.

Reflection

How does this problem relate to division?

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Solve a given single-variable multiplication equation with an unknown
- Solve problems involving one-step equations

Go online to complete the Concept Capsule about Problem Solving Using Concrete Models (Multiplying and Dividing).

Multiplication Equations

Multiplication equations look like this:

4x = 16 **5y = 35** **102 = 6m**

The variable is written beside the number. This means that the number is being multiplied by the unknown.

5m — Means → **5 times the unknown m**

You may wonder why you don't use the multiplication symbol when multiplying by a variable. The symbol **x** is often used for multiplication. The letter **x** is also used as a variable in an equation. You cannot use the multiplication symbol **x** and the variable **x** in the same equation because it is too confusing.

Multiplication can be expressed with brackets:

3(4) — Means → **3 times 4**

The number in front of the variable is called the coefficient.

4x = 12 — Coefficient

24 = 6h — Coefficient

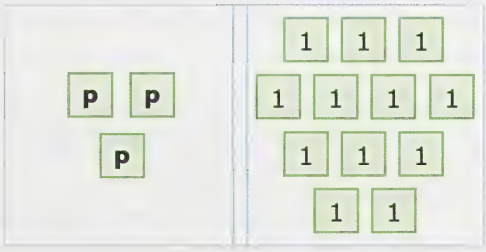
The coefficient is the number multiplied by the unknown.

Modelling Multiplication Equations

Here is a model of a multiplication equation using algebra tiles and a two-part mat.

3p = 12

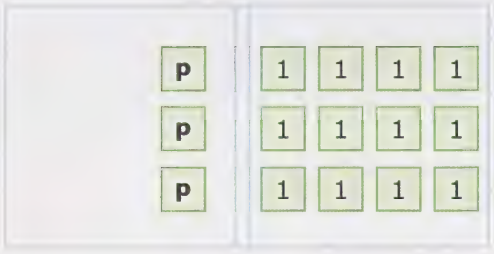
The variable side of the equation is 3 times the unknown, **p**. This side is modelled by 3 unknown tiles.



This right side is modelled by 12 ones tiles.

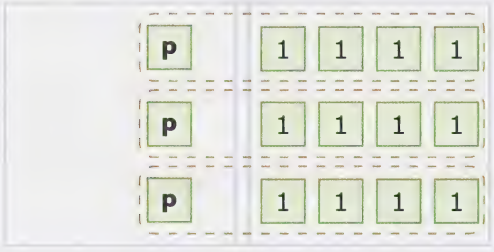
This models the fact that 3 **p**s equal 12 ones. What is the value of one **p**? To find the answer, begin by arranging the ones tiles into 3 equal rows to match the **p**s.

3p = 12



This arrangement shows you that each **p** on the left is matched to 4 ones on the right.

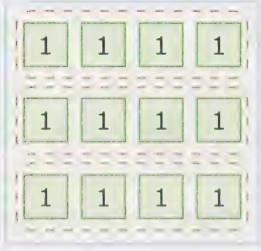
p = 4



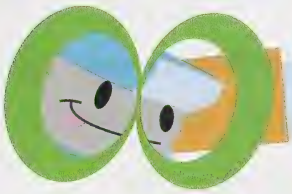
The answer is p = 4. This is represented by the matching of each **p** to 4 ones.

Division is modelled in a similar manner:

12 ÷ 3 = 4



12 has been divided into 3 equal parts of 4.
The answer is the number of ones in each of the 3 parts.



Let's Explore

Exploration 1: Solving Multiplication Equations

Materials: Algebra Tiles, Two-part mat, Paper, Pencil

Create the models for each of the following equations and solve using Algebra Tiles.

Can you discover the rule for solving multiplication equations?

1. $2h = 14$
2. $3r = 6$
3. $5w = 15$
4. $4y = 20$
5. The rule for solving a multiplication equation is:

   _____ divide both sides by the coefficient of the variable.

   The property that allows you to divide both sides by a number is the division property of equations:

The Division Property of Equality
Two sides of an equation remain equal if both sides are divided by the same number.

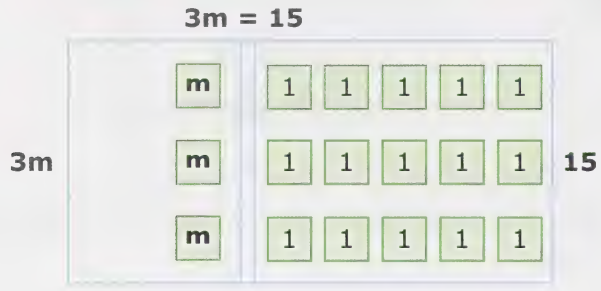
Division of two numbers can be written like this:

$\frac{x}{12}$ Means x divided by 12 $\qquad$ $\frac{14}{7}$ Means 14 divided by 7

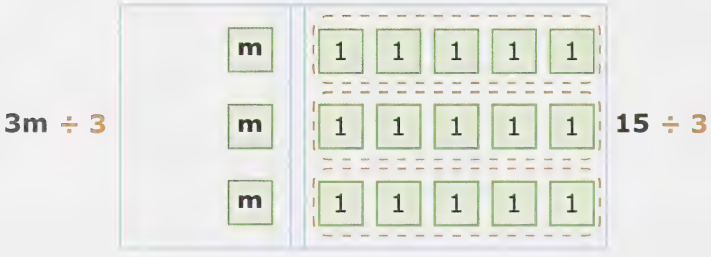
This method for division is used often with equations.

Solving Multiplication Equations Using the Rule

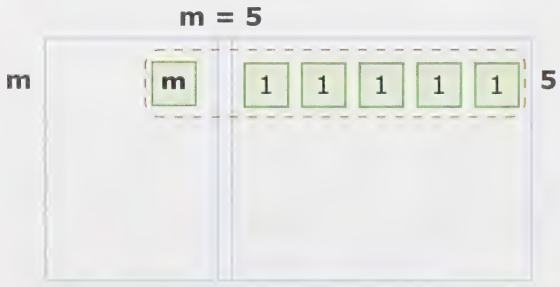
How the model relates to the rule:



Divide both sides by 3:



The number left in each grouping is the answer:

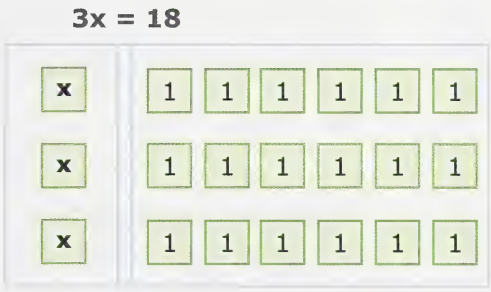


Example 1

Use the model and the rule to solve $3x = 18$

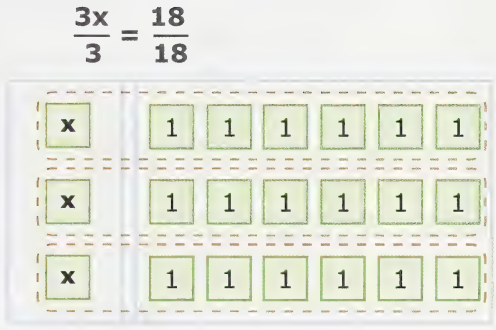
1. Write the equation:

   $3x = 18$



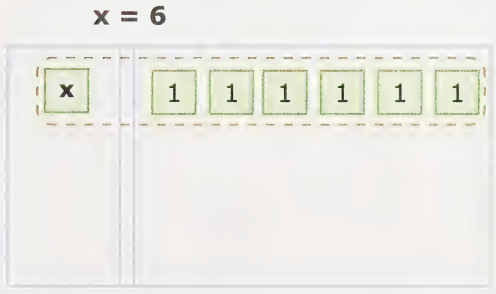
2. Divide both sides by the coefficient, 3:

   $\frac{3x}{3} = \frac{18}{3}$



3. Write the answer:

   $x = 6$



Now try one without the model. To check if you did it correctly, put the number back in the equation and multiply. If the statement is true then it is correct.

Example 2

Use the division property of **equality** to solve

$10x = 50$

1. Write the equation:

   $10x = 50$

2. Divide both sides by the coefficient of x, 10:

   $$\frac{10x}{10} = \frac{50}{10}$$

3. Write the solution:

   $x = 5$

4. Check by putting $x = 5$ back in the equation:

   $10x = 50$

   $10(5) = 50$

   $50 = 50$

   Brackets ( ) Mean Multiply

5. The answer is: $x = 5$

You can organize the problem like this on your paper:

$10x = 50$	Check
$\frac{10x}{10} = \frac{50}{10}$	$10x = 50$
	$10(5) = 50$
$x = 5$	$50 = 50$ ✓

Variables in Different Positions

You might find that the variable appears on the other side of the equation. This does not change how you solve. Use the same steps to solve.

Example 3

Solve 24 = 4m

1. Write the equation:

   24 = 4m

2. Divide both sides by the coefficient 4:

   $$\frac{24}{4} = \frac{4m}{4}$$

3. Write the solution:

   6 = m

4. Check the solution:

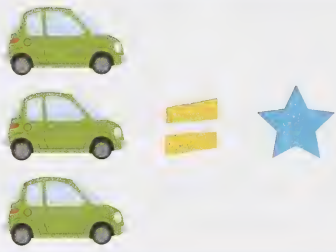
   24 = 4(6)

   24 = 24

5. The answer is: 6 = m OR m = 6

When the problem is switched around it doesn't matter which way you write the answer. Remember, the answer is the value of the variable.

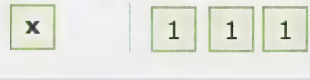
In pictures:

x = 3	3 = x
	

In words:

x = 3	3 = x
"x represents 3 cars"	"3 cars are represented by one x"

With models:

x = 3	3 = x
	

Now It's Your Turn

Solve and check each equation.

a. $4j = 12$

b. $2k = 26$

c. $45 = 15w$

d. $60 = 12x$

Solutions

a. j = 3

b. k = 13

c. w = 3

d. x = 5

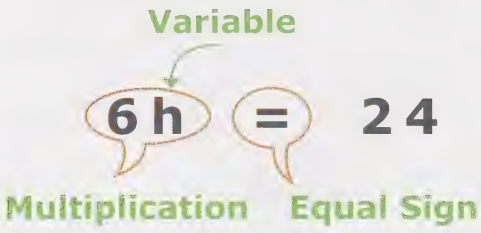
- In your Workbook turn to Unit 2, Lesson 7 and complete 1 to 20.

Problem Solving with Multiplication Equations

Multiplication equations have clue words to let you know to multiply.

Variable	Equal Sign	Multiplication
a number	is	of
some number	equals	times
what number	gives	each
	yields	multiplied by
	are	product of
	were	increased by
	will be	twice

You can use the clue words to identify the parts of the equation.



Here are some sentences that have been written as multiplication equations.

Words	Equations
7 times a number is 14	7x = 14
the product of a number and 3 is 27	3y = 27
twice a number equals fourteen	2n = 14
twelve multiplied by a number is 36	12w = 36

Here is an example of how to write a multiplication equation from a sentence:

Example 4

Write an equation for the sentence:
The product of a number and 8 is twenty-four.

1. Circle the operation and equation words.

the product of a number and 8 is twenty-four

2. Underline the words for numbers and for the variable.

   the product of a number and 8 is twenty-four

3. Write the numbers and the variable above their words.

   x 8 24

   the product of a number and 8 is twenty-four

4. Place the equal sign over the word "is."

   x 8 = 24

   the product of a number and 8 is twenty-four

5. The left side is "the product of **x** and 8" or **x** times 8. The coefficient must be before the variable:

   8x

6. Put the left side together with the rest to get the answer:

   8x = 24

Now It's Your Turn

Write an equation for each sentence.

a. A number multiplied by twelve is 84.

b. 21 equals some number times seven.

Solutions

a. 12n = 84

b. 21 = 7y

Let's Practice

Go online to watch the Notepad Tutor about Multiplication Equations.

- In your Workbook turn to Unit 2, Lesson 7 and complete 21 to 27.

Lesson 8

Division Equations

Home Organization

Alyssa is well organized. She wants all of her purses to be lined up on 3 shelves in her closet, with 4 purses on each shelf. Alyssa must have exactly enough purses to organize her closet this way. This means that Alyssa has 12 purses.

In this problem, Alyssa needed to find out how many purses she could arrange in the way she wanted. This involved filling each position until the purses were organized.

Reflection

How does this relate to a multiplication equation?

Objectives for this Lesson

In this lesson you will explore the following concepts:

- Solve a given single-variable division equation with an unknown
- Solve problems involving one-step equations

Division Equations

Division equations will look like this:

$x \div 4 = 6$ $\qquad \frac{y}{3} = 12$ $\qquad 32 = \frac{m}{2}$

The inverse operation of multiplication is division. You used this in solving multiplication equations in Lesson 7. Look at the relationships in these equations:

Multiplication	Division
$4(12) = 48$	$48 \div 12 = 4$
$3(5) = 15$	$\frac{15}{5} = 3$
$6(7) = 42$	$\frac{42}{7} = 6$

The inverse operation of division is multiplication. This property allows you to solve division equations.

Modelling Division Equations

You can use cups and counters as one way to model a division equation.

Example 1

Solve $x \div 6 = 3$ using cups and counters.

1. Since the variable is divided by 6, you need 6 cups or counters.

2. The right side is 3 so we need to fill each cup with 3 counters.

3. The answer is the total number of counters in the model.

   The answer is: **x = 18**

Another way to model an equation is to use an area model.

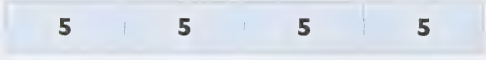
Example 2

Solve $\frac{c}{4} = 5$ using a visual model.

1. Draw a picture of the variable as a rectangle.

2. Since the variable is divided by 4 in the equation, divide the rectangle into 4 equal parts.

3. Now place 5 in each section.



4. How many are in the total?

   c = 20

Look at instruction 3 of this example. There are 4 sections of 5 for a total of 20. This means that to solve the equation, you multiplied 4 times 5.

The Multiplication Property of Equality

The two sides of an equation remain equal if both sides are multiplied by the same number.

Remember, the inverse of division is multiplication. You can multiply both sides of the equation by the divisor to get the solution.

$\frac{c}{4} = 5$	Equation
$(4)\frac{c}{4} = 5(4)$	Multiply both sides by the divisor.
$c = 20$	Answer

Exploration 1: Division Equations

Materials: Unit 2, Lesson 8, Exploration 1 page from your Workbook, paper, pencil

Solve the following division equations using the rectangle provided. Separate the rectangle into the sections needed to model the problem.

1. $\frac{m}{3} = 4$
2. $\frac{m}{2} = 3$
3. $\frac{m}{6} = 3$
4. $\frac{m}{5} = 4$

5. What is the operation that you would use to find the answer?
6. Can you find the answer using the operation without the model? Why or why not?

Solving Division Equations Using the Rule

Now try solving one without a model. To check and see if you are correct, put the number back in the equation and divide. If the statement is true, it is correct.

Example 3

Solve $\frac{n}{3} = 8$ using the rule for division equations and check.

1. Write the equation.

   $\frac{n}{3} = 8$

2. Multiply both sides by the divisor 3.

   $(3)\frac{n}{3} = 8(3)$

3. Write the solution.

   n = 24

4. Check the solution:

$\frac{n}{3} = 8$	Check
$(3)\frac{n}{3} = 8(3)$	$\frac{24}{3} = 8$
$n = 24$	$8 = 8$ ✓

This is what the entire problem will look like on your paper.

5. The answer is: n = 24

Now It's Your Turn

Solve and check each equation.

a. $j \div 3 = 5$

b. $\frac{h}{6} = 2$

c. $\frac{t}{4} = 7$

Solutions

a. j = 15

b. h = 12

c. t = 28

Let's Practice

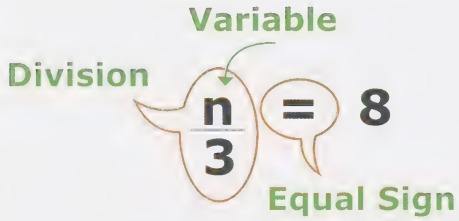
- In your Workbook turn to Unit 2, Lesson 8 and complete 1 to 18.

Problem Solving with Division Equations

Division equations have clue words to let you know that you need to divide.

Variable	Equal Sign	Division
a number some number what number	is equals gives yields are were will be	per a out of ratio of quotient of divided by

You can use the clue words to identify the parts of the equation.



Here are some sentences that have been written as division equations.

Words	Equations	
the quotient of a number and 3 is 5	$n \div 3 = 5$	$\frac{n}{3} = 5$
a number divided by 4 equals six	$y \div 4 = 6$	$\frac{y}{4} = 6$

Here is an example of how to write a division equation from a sentence:

Example 4

Write an equation for the sentence:

A number divided by seven equals nine.

1. Circle the operation and equation words.

   A number **divided by** seven **equals** nine.

2. Write the division symbol and equal sign over the clue words.

   ÷ =

   A number **divided by** seven **equals** nine.

3. Underline the words for the numbers and for the variable.

   ÷ =

   A number **divided by** seven **equals** nine.

4. Write in the variable and numbers.

   b ÷ **7** = **9**

   A number **divided by** seven **equals** nine.

5. Write the equation.

   b ÷ 7 = 9

Now It's Your Turn

Write an equation for each sentence.

a. The quotient of a number and eleven is 10.

b. A number divided by six equals twelve.

c. A number divided by four equals two.

Solutions

a. $n \div 11 = 10$

b. $y \div 6 = 12$

c. $b \div 4 = 2$

Let's Practice

Go online to watch the Notepad Tutor about Division Equations.

- In your Workbook turn to Unit 2, Lesson 8 and complete 19 to 24.

Lesson 9

Problem Solving with Equations

Problems Everywhere

When a problem is presented it will have a real life context. You need to be able to decode the words of the context to write an equation. This will help you when the problems get bigger.

Have you ever walked into the grocery store and seen a sign like this?

A sign like this would seem strange to most people. The sign gives information as a math equation. What you will see when you walk into a store is a sign like the second one.

How much will one can cost? You can answer that question using the equation on the first sign. The first sign has the equation for the question: "How much does one can of peas cost?" The second sign has the information for how much 2 cans of peas will cost.

Reflection

How would you solve the problem to find the cost?

Objectives for this Lesson

In this lesson you will explore the following concepts:

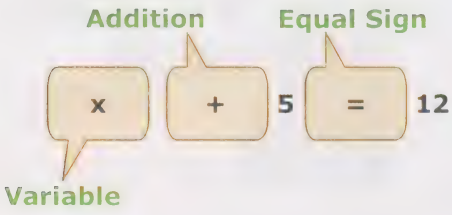
- Express a given problem as an equation where the unknown is represented by a letter variable
- Create a problem in context for a given equation

Go online to watch the Notepad Tutor about Problem Solving with Equations.

Solving Addition Word Problems

Solving a **word problem** is like writing an equation. The **clue words** may still be there in the problems.

Think about the parts of an addition equation:



Example 1

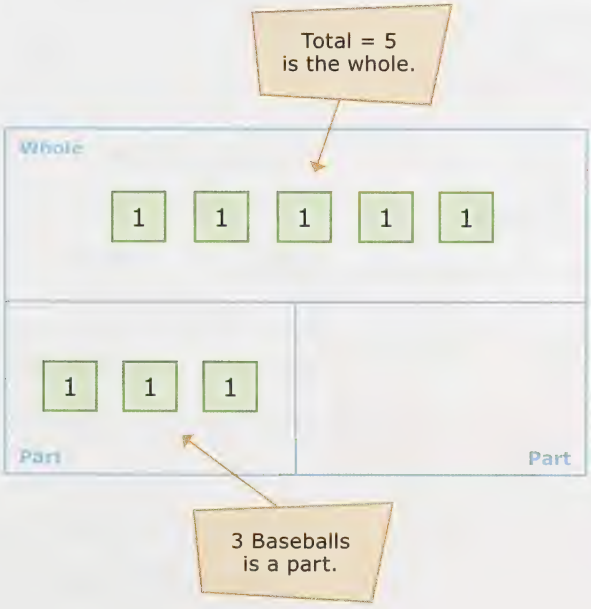
Write an equation for the word problem and solve.

Daksha's team has 3 baseballs for the game tonight against Lian's team. The teams must have a total of 5 baseballs to start the game. How many baseballs does Lian's team need?

1. Write a relationship for the word problem:

Number of Baseballs (Daksha's Team) + Number of Baseballs (Lians's Team) = Number of Baseballs Needed

Or you can use a part-part-whole model:



The missing part is unknown and will be replaced with a variable.

2. Replace the parts of the relationship with the numbers you know:

$$3 + \text{number of baseballs for Lian's team} = 5$$

3. Use a variable to represent the unknown:

$$3 + b = 5$$

4. Solve using the rule for addition equations. Subtract 3 from both sides:

$$3 + b = 5$$

$$3 - 3 + b = 5 - 3$$

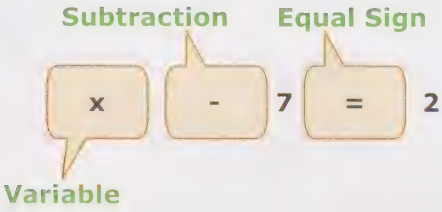
$$b = 2$$

5. Write the solution statement as a sentence:

Lian's team needs 2 baseballs.

Subtraction Equations

Think about the parts of a subtraction equation:



Now that you have experienced both addition and subtraction equations it is time to mix them up.

You can use the part-whole concept to help you decide if they are addition or subtraction problems.

Part + Part = Whole
Whole - Part = Part

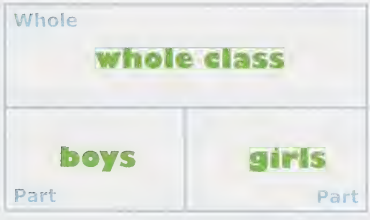
If a part is missing, it is an addition equation. If the whole is missing, it is a subtraction equation.

Example 2

Write an equation for the word problem and solve.

Mrs. Kung's class has 18 boys. There are 12 girls in the class. How many students are in the class?

1. Identify the parts of the part-whole relationship for the word problem:



Whole = total number of students
Part = 18 boys
Part = 12 girls

2. Select a variable for the unknown:

   T = total number of students

3. Write the equation using the part-part-whole model:

   Whole – Part = Part

   T - 18 = 12

4. Solve using the rule for subtraction equations.

$$T - 18 = 12$$
$$T - 18 + 18 = 12 + 18$$
$$T = 30$$

5. Write the solution statement as a sentence:

   There are 30 students in Mrs. Kung's class.

Example 3

Nina wants to read 45 books this year. She has already read 21 books. How many more does she need to read?

1. Identify the parts of the part-part-whole relationship for the word problem:

   Whole = 45 books
   Part = 21 books
   Part = number she still needs to read

2. Select a variable for the unknown:

   b = the number of books Nina still needs to read

3. Write the equation using the part-whole model: Part + Part = Whole

   $b + 21 = 45$

4. Solve using the rule for subtraction equations.

$$b + 21 = 45$$
$$b + 21 = 45 - 21$$
$$b = 24$$

5. Write the solution statement as a sentence:

   Nina still needs to read 24 books.

Let's Practice

- In your Workbook turn to Unit 2, Lesson 9 and complete 1 to 5.

Let's Explore

Exploration 1: Problem Solving with Addition and Subtraction Equations

Materials: Unit 2, Lesson 9, Exploration 1 page from your Workbook, Pencil

1. Write a word problem that will translate into an addition equation. Write the equation and solve the problem.
2. Write a word problem that will translate into a subtraction equation. Write the equation and solve the problem.

Solving Word Problems with Multiplication and Division Equations

Word problems that may be written as multiplication and division equations will have the form:

$4x = 12$ $12 \div x = 4$

You will need to identify the parts of the equation. One way is to write a sentence for the problem, similar to the sentences you learned to write in the other lessons. Use clue words to decode the problem.

Example 4

There are some children playing tennis. Each child has 6 tennis balls. All together, there are 48 tennis balls. How many children are playing tennis?

1. What are you looking for?

   You are looking for the number of children that are playing tennis.

2. What information do you have?

   Each child has 6 tennis balls.There are 48 total tennis balls.

3. Identify the variable.

   There are "some" children playing. The variable will be c = number of children playing

4. Put it all together to write an expression:

   c children have 6 tennis balls each for a total of 48 tennis balls.

   The word "each" means to multiply.

   You will multiply the **c** and the 6. The "total of" is the equal sign.

5. The equation is:

   $6c = 48$

6. Solve the equation and check.

$\frac{6c}{6} = \frac{48}{6}$

$c = 8$

Check

$6(8) = 48$

$48 = 48$ ✓

7. Write the solution as a sentence.

There are 8 children playing tennis.

Example 5

Write an equation and solve.

Eight children are gathering strawberries. When they are done there are six filled buckets of strawberries per child. How many buckets did they fill all together?

1. What are you looking for?

You are looking for the number of buckets filled with strawberries.

2. What information do you have?

Each child filled 6 buckets. There are 8 children.

3. Identify the variable.

b = number of buckets

4. Put it all together to write an expression:

b buckets divided by 6 buckets per child equals 8 children.

5. The equation is:

   $b \div 6 = 8$

6. Solve the equation and check.

$\frac{b}{6} = 8$	Check
$(6)\frac{b}{6} = 8(6)$	$\frac{48}{6} = 8$
$b = 48$	$8 = 8$ ✓

7. Write the solution as a sentence.

   The children filled 48 buckets with strawberries.

Let's Explore

Exploration 2: Problem Solving with Multiplication and Division Equations

Materials: Unit 2, Lesson 9, Exploration 2 page from your Workbook, Pencil

1. Write a word problem that translates into a multiplication equation. Write the equation and solve it.

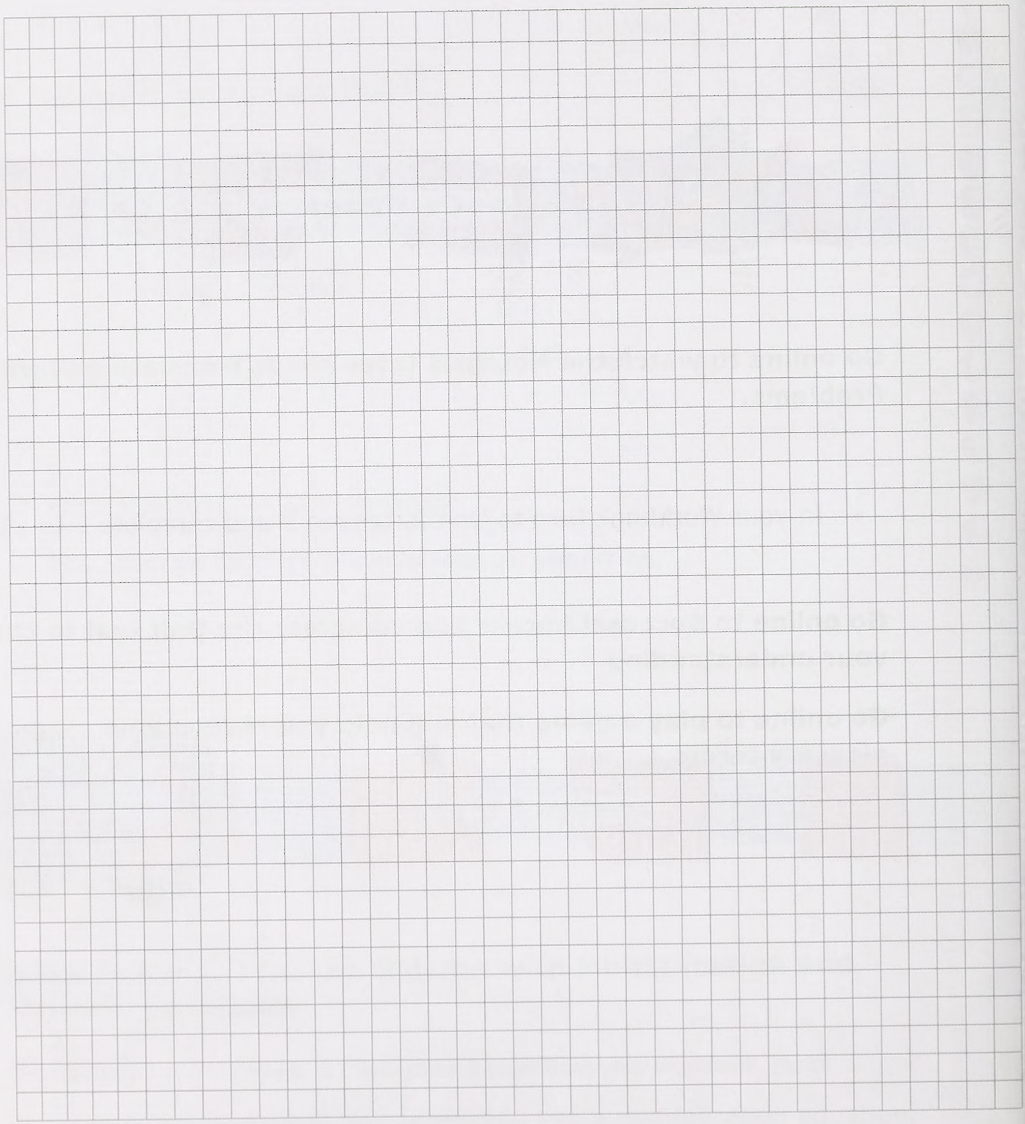
2. Write a word problem that translates into a division equation. Write the equation and solve it.

Go online to watch the Notepad Tutor about Translating Word Problems.

- In your Workbook turn to Unit 2, Lesson 9 and complete 6 to 15.

Go online to SuccessChecker and complete the Unit test to check your understanding.

Go online to play a game that will help you review your glossary terms.



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